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Forthcoming Events.

MARCH 6.

Institute of Metals (Sheffield Local Section):—Ordinary meeting at Sheffield. "The Evolution of the Furnace." Paper by J. A. Lee.

MARCH 7.

Institute of British Foundrymen (Sheffield Branch):—Ordinary meeting at Sheffield. "Centrifugal Castings." Paper by R. A. Miles.

Institute of British Foundrymen (East Midlands Branch):—Joint meeting with Sheffield Branch, at Sheffield. "Centrifugal Castings." Paper by R. A. Miles.

MARCH 9.

Institute of British Foundrymen (Burnley Section of the Lancashire Branch):—Ordinary meeting at Burnley. "Some Examples of Plate Moulding." Paper by E. Flower.

Institute of Metals (Scottish Local Section):—Ordinary meeting at Glasgow. "Electric Furnaces." Paper by A. Glynne Lobley.

MARCH 11 and 12.

Institute of Metals:—Annual general meeting in London.

THE FOUNDRY TRADE JOURNAL IS THE OFFICIAL ORGAN OF THE INSTITUTE OF BRITISH FOUNDRYMEN; THE WELSH ENGINEERS' AND FOUNDERS' ASSOCIATION, AND THE FOUNDRY TRADES EQUIPMENT AND SUPPLIES ASSOCIATION.

Institute of British Foundrymen.

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Foundry Trades Equipment & Supplies Association.

Secretary: K. S. Bridges, Avenue Chambers, Southampton Row, London, W.C.1.

The Scope and Progress of Non-Ferrous Foundry Research.

The British Non-Ferrous Metals Research Association, of 71, Temple Row, Birmingham, has just issued a booklet describing some 25 investigations which it has in progress or has completed. The policy of this Association has always been to concentrate its energies on substantial experimental work, and for these purposes to utilise to the utmost existing laboratory facilities. Thus these researches are located at the National Physical Laboratory; the Research Department, Woolwich; at several of the Universities; and in the works of its members.

Only recently has it been decided to supplement this method by the equipment of a small laboratory of its own, which is now being organised in a building placed at its disposal by the Birmingham University, and here special work unsuited for other laboratories, or the preliminary survey of new problems, will be undertaken.

The pamphlet referred to gives brief and clear descriptions of the aims, progress and practical applications of the individual researches, which cover a wide field; in fact, the Association is to be congratulated on the breadth of its programme, which appears to us to provide something for all its members, whose interests are scattered amongst many branches of the engineering industry as well as in the actual foundry field itself. In this column it is impossible to define all these investigations, but it may be sufficient to mention that they comprise several on copper and brass, others on aluminium, zinc, lead and nickel.

Special mention may, however, be made of the important engineering problem of the prevention of wastage of locomotive fire-box stay rods, in which work the Association has secured the financial support and active assistance of the railways and their chief mechanical engineers. Another investigation of an engineering nature deals with non-ferrous alloys for high temperature service; at present the work consists in a thorough study of the mechanical properties of nickel-chromium and nickel-copper alloys up to 700 deg. C., but it is proposed to supplement this by a search for new alloys possessing superior heat-resisting qualities. Modern power-production advance and the requirements of the metallurgical and chemical industries should benefit from this development of the programme. A few of the other researches, since they specially concern the foundry industry, may also be referred to.

The production of strip brass ingots with improved surface and internal soundness, as the basis for the production of better sheet metal, forms one of the larger researches, and is being undertaken by a team of workers at the Research Department, Woolwich. Eight confidential reports have so far been made available, so the work is apparently making progress. Another quite basic metallurgical problem has been taken up for the Association in Professor Edward's laboratory at Swansea, and deals with the elimination of gases from copper and other castings. It is claimed that results of great practical importance have been obtained with copper, and that the work will be extended to its alloys.

The tri-partite investigation on die-casting alloys will also be watched with interest by foundrymen, as it is evidently planned on ambitious and extensive lines, and is intended to provide information on the best alloys for die casting and methods of overcoming some of the inherent difficulties in their production; the three sections deal respec-

tively with brass and bronze alloys, aluminium alloys, and low melting-point alloys, especially those of zinc.

The progress made in the last year or two is very substantial, and must be encouraging to the early supporters. The experimental research undertaken by the Association is costing at present £16,000 per annum.

The list of reports available to its members and the indication of the service which its Information Bureau is affording show that in other directions also the Association is doing good work.

Whilst still relying to a great extent on the financial support and the encouragement of the Government Research Department, the Association intends to make a great effort to become self-supporting—one of the conditions of early Government support—it is obvious that nothing less than its present scale of operations could suffice to cover adequately the non-ferrous metallurgical field.

Even from its early work, when the scale of operations was smaller, results of evident practical value have accrued, and now that progress is assured in rapidly increasing measure an appeal is made to other firms in the non-ferrous metals industry to come forward and share the obligations and the rewards of work which is necessarily co-operative in execution and mutually beneficial in results.

Dr. R. S. Hulton, the Director, is always at the personal service of non-ferrous foundrymen to explain to them the service which the Research Association renders to its members.

Correspondence.

[*We accept no responsibility for the statements made or the opinions expressed by our correspondents.*]

Desulphurisation of Cast Iron.

To the Editor of The Foundry Trade Journal.

Sir,—In view of the article and your leader thereon, which appeared in last issue of The Foundry Trade Journal, the following facts may be of interest.

The method has recently been tried out at a Dublin foundry, but so far only on a small scale, as the immediate object was to test the claim that a slag composed of anhydrous sodium carbonate was capable of acting right through a shank of molten cast iron.

A 100 lb. shank was used, care being taken to remove the original slag as completely as possible. The temperature was medium, and the jobs to be cast small, so the operation was hurried. Fused soda ash, in the proportion of one half of one per cent., was added, it rapidly fused, giving an extremely fluid slag, which was allowed to remain for 2½ minutes; this was thickened by the addition of dry slaked lime, and skimmed off.

The following results were obtained: Sulphur in untreated metal, 0.145 per cent., and in a sample from first metal poured, 0.11 per cent. A sample from the last metal poured showed no difference from the 0.11 per cent. figure.

It is therefore plain that the action extends right through the metal treated, and, in this case, the reduction amounted to approximately 25 per cent. Under all the circumstances of the experiment, this must be considered satisfactory, for a first attempt; but, it is evident, in view of the extremely thin nature of the basic slag, that some skimming device will prove to be necessary.

The writer also understands that the "Walter" process embodies a syphon block in the cupola, so as to ensure the absence of original slag. Provided the metal is hot, and the slag is removed, the method appears promising, as the difficulties were limited to the removal of slag, and shortage of time. Doubtless, given time in a "Bull" ladle, sulphur removal would be much more complete, as there was no indication of a purely local action.

Yours, etc.,

H. Grattan.

45, Synge Street, Dublin.

[We always understood that Mons. Ronceray was the inventor of the syphon brick as applied to cupolas.—Editor.]

A Note on the Structural Composition of Cast Iron.

By J. E. Fletcher (Consultant B.C.I.R.A.)

Foundry metallurgists will have noted recently the increasing prominence given to the method of expressing the chemical analyses of cast iron in terms of the structural composition.

The writer has made use of this useful method since 1900, when MM. Carnot and Goutal published in the "Annales des Mines," their researches on the chemical constitution of cast iron and steels.

In the absence of reliable values for the specific densities of the various constituents near approximations were used by the writer, obtained from weight determinations of ferro-silicons, ferro-manganese and spiegels, white Swedish pig-irons, etc. By such approximate means it was possible to visualise the volumetric composition.

Later, help was given by Stead, who, in his remarkably lucid manner showed in 1910 the value of the volumetric constitutional analysis of ores, slags and cast iron. (See "Iron and Coal Trades Review" of May 20, 1910.) He was even then obliged to use approximate specific gravity values. In 1907, the writer was at work on the problem and had obtained a number of useful density values by actual weight of many samples collected from various sources and from materials used in his own foundry practice. These figures were given in a paper "On the influence of gases on the structure of cast iron and steel" (Staffs I. and S. Inst., 1907), and in a later paper on the 4.3 per cent. carbon eutectic (Staffs I. and S. Inst., 1914), the structural composition of cast iron was further dwelt upon in detail. Since then, in other published works the writer has used the method in dealing with open-hearth steel and puddled iron practice.

Howe and Sauveur have both dealt with the volumetric composition of steel and cast iron, the former giving the density values of some of the constituents, but corroboration of these figures is desirable. This matter is having the attention of the Cast Iron Research Association in connection with systematic methods for relating what may be termed micro-area analysis with the volumetric and constitutional compositions of cast iron. In any such computed analyses the necessity for correct constants is indispensable. The unavoidable presence of gases in cast metals makes the determination of densities very difficult and some of the published values for certain constituents require checking, notably the carbides, silicides, sulphides and phosphides. It would seem, indeed, that as cast iron is never perfectly solid, certain constituents are, in actual practice, always porous when present in pig-irons, the porosity being modified by later remelting and heat treatment. The differences in the density values due to such influences would seem to merit further research.

The two values for the density of cementite in low and high carbon steels and cast iron are cases in point (Benedick's determinations). Longmuir also called attention to the area of sulphide inclusions in iron, as microscopically revealed. The writer has noted this, and feels that the figures given for the specific gravity of iron and manganese sulphides (varying from 4.0 to 6.15) are unsatisfactory, the variations in the determinations being possibly due to gaseous inclusions.

Mr. Logan's paper is timely and touches an important problem, related as it is with the common-sense interpretation of chemical analysis, especially as related to cast iron.

"Works Pyrometry" was the subject of a lecture by Mr. G. E. M. Stone, given to the Birmingham Metallurgical Society, last Thursday evening.

Mr. J. M. Espana, a director of the S.A. Etabs., Ph. Bonvillain and E. Ronceray, of Paris, has been made a Commander of the Order of Isabel la Catolica by the Spanish Government, for the improvement of foundry practice in Spain.

The Improved Peacolt Moulding Machine.

It is being increasingly realised that the foundry is the foundation upon which the works must stand or fall. To take one point alone, the saving in machining costs effected by sound, clean and accurate castings may in these days of keen competition represent the difference between profit and loss. In the foundry itself the saving in labour, material and scrap, together with increased output and reduction of overhead charges, repays judicious capital outlay over and over again.

With the clearer realisation of these facts there is evident in the trade generally a marked interest in new foundry appliances designed to improve practice and promote efficiency. Viewed at first by hand moulders with perhaps not unnatural misgiving, experience has proved not only that moulding machines lighten labour, but that operators can earn increased wages, and that better economic conditions enable the management to take on more hands than before.

A notable addition to these products is the Improved "Peacolt" Moulding Machine, manufactured at the Manchester works of the Pneumatic Engineering Appliances Company, Limited, of Donington House, Norfolk Street, W.C.2. In the short time that this machine has been on the market it has met with distinct success.

By courtesy of Messrs. J. Stone & Company, Limited, we are enabled to reproduce photographs of the No. 4 Improved "Peacolt" (Figs. 1, 2 and 3) recently installed at their Deptford works, which will serve to illustrate the general design and operation of this interesting machine. It is of the turnover type, but by removal of the turnover table and substitution of lifting-brackets, is convertible in a few minutes to direct-draw or stripping-plate operation, a feature which the makers claim to be unique. The turnover-table trunnions are adjustable to two centres, for the approximate balance of deep or shallow boxes, and —another point found only on this make—this adjustment involves no loss of depth of maximum pattern-draw.

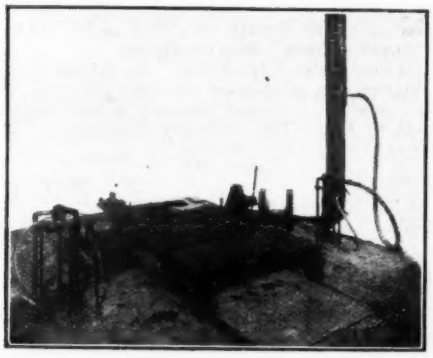

FIG. 1.—TURNOVER TABLE AND PATTERN IN POSITION TO RECEIVE MOULDING BOX. THE MACHINE IS SUNK IN AN ENCLOSED PIT, WITH READY ACCESS FOR INSPECTION, ETC.

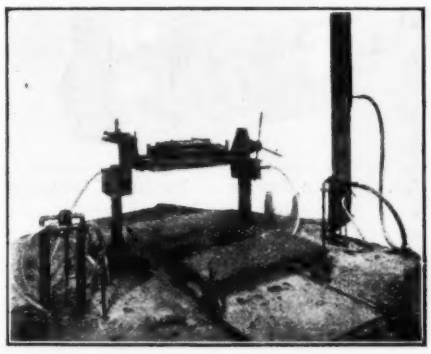

FIG. 2.—TURNOVER TABLE RAISED. THE MOULD-CARRIAGE IN THE FOREGROUND RUNS ON BALL-BEARINGS, AND THE HEAVIEST MOULDS CAN BE HANDLED.

During the jarring operation, which consolidates the sand about the pattern, it was observable that there was an entire absence of rebound of the jarring table, which, when present, results in stratification of the sand and a breakaway when the pattern is drawn, or when the mould is turned over. This absence of rebound is due to the design of the dirt-proof jarring valve, and to the fact that the force of impact can be adjusted with nicety to the weight of the mould. Within wide limits of weight, however, this adjustment —which is effected by a simple throttle on the exhaust—is not required. A further detail ensuring satisfactory consolidation is that the turnover table and mould, during jarring up, rise and fall in machined guides, the movement being truly vertical and without side play.

Screws attached to the lifting piston-rod brackets enable the box to be accurately levelled prior to drawing the pattern, and once set for any particular box, these require no further adjustment. The movement of a small lever then locks the box in position, and ensures a dead-true pattern-draw. It was noticeable that even when the side lifting pistons were at the extremity of their upward stroke there was no sign of shake, and also that the pistons rose in absolute unison. This rigidity and synchronised movement are attained by guide-racks of substantial section, which are bolted to the lifting piston-rod brackets, and rise and fall parallel with the piston rods in enclosed channels machined in the cylinder castings. The lower ends of these guides are mechanically interconnected by rack-and-pinion and a cross-shaft, and it is therefore impossible for one piston to rise or fall in advance of the other.

All these details, however, important as they are, are subsidiary to the principle upon which the machine operates, and to which its success is mainly attributable. This is the new system of oil-controlled pattern-drawing which it embodies, and which again is found in no other make on the market. Compressed air, of course, is a highly elastic medium, and it is impossible to regulate it with that absolute nicety necessary for a perfect pattern-draw. During the drawing operation the lifting pistons meet with varying resistances; for example, dead-weight load, initial adhesion of pattern to mould, and mechanical friction. These varying resistances cause the air pressure to pile up beneath the pistons, and when the resistance is overcome the air expands suddenly and causes the pistons to rise with a jerk. Any jerky movement, naturally, is highly detrimental to the mould, causing breaking away of the sand and necessitating subsequent patching or scrapping.

This jerky pattern-drawing, which in the past has been the chief point of criticism against most moulding machines, has now been completely overcome by the employment of what is in principle an adjustable oil-brake. Compressed air is admitted at full pressure to an oil-tank formed in the base of the machine, and forces the oil through a special control-cock to the bottom of the lifting cylinders. Oil, unlike air, is a virtually incompressible medium, and the speed at which it will pass through a given aperture depends upon the viscosity of the oil and the pressure behind it, which for this purpose are constants. Regulation of the oil control-cock therefore determines the speed at which the lifting pistons will rise, and in the Improved "Peacolt" this is controlled with an accuracy which entirely eliminates breaking away of the sand.

For demonstration purposes the pattern-drawing movement can be so regulated as to be almost imperceptible, like that of the hand of a clock. Whilst this is not required in practice, it is essential that the first half-inch, say, of the draw should be slow and dead steady, the movement being speeded up once the pattern is free, and this is provided for in an ingenious manner by the special control-cock—which, incidentally, com-

prises a dual set of ports simultaneously controlling both oil and air. This cock is provided with stops, against which the handle comes in the course of movement, and which are so positioned as to give the required openings without any "feeling" for them on the part of the operator.

Starting at the beginning of the pattern-draw, movement of the handle to the first stop starts the vibrators, the lifting pistons remaining stationary. After a few seconds the handle is passed to the second stop, vibration continuing and pistons rising slowly. As soon as the pattern is free, the handle is turned to full open. This movement stops vibration—continuance of which is unnecessary and may be actually detrimental at this stage—and the remainder of the draw is made at much higher speed. When lifting the mould for turning over prior to drawing the pattern, the control-cock handle, of course, passes the stops in one movement to full open, and the lift is made at speed.

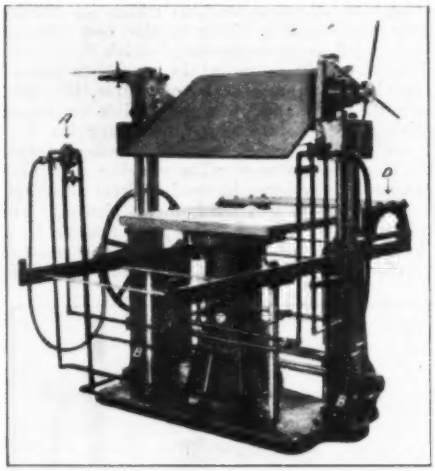

Fig. 3.—The Improved Peacolt Moulding Machine before Installation.

It is thus apparent that the production of moulds has been reduced by this machine to a mechanical process requiring a minimum of skill on the part of the operator. Moulds of consistently uniform character—a virtual impossibility with hand moulding—are produced, and the rate of output is far higher than can be attained by the most skilled hand worker.

There are many other interesting features, detailed reference to which space will not permit, but mention should be made of the ease and simplicity of operation of the machine, which is controlled by two cocks only—one for jarring-up the mould and another for lifting and pattern-drawing. It is evident that the Improved "Peacolt" is the outcome of long practical experience of foundry problems and conditions, and the fact that it has been largely adopted by the Railway Groups and leading private foundries, for mass production of the R.C.H. Standard axle-box, is sufficient evidence of its performance.

Company Meeting.

The annual general meeting of the General Refractories Company, Limited, was held on February 23, at the Royal Victoria Hotel, Sheffield, and was well attended.

The chairman, Mr. Frank Russell, announced that despite keen competition, and a measure of depression in the steel trade, the sales for the year had been larger than during any previous year, with the exception of the boom year of 1920 when prices were very much higher.

The results of trading during the year could not be considered other than satisfactory, and would permit of the usual dividend, with a substantial sum carried to reserve.

The meeting ended with a vote of thanks to the directors and staff, after which all present lunched together on the invitation of the company.

Correspondence.

[We accept no responsibility for the statements made or the opinions expressed by our correspondents.]

Defacement of Light Grey Iron Castings.

To the Editor of the Foundry Trade Journal.

Sir,—Your reader who complains of defacement of light grey iron castings is probably troubled by the fact that his facing sand is much too strong for his class of work. I am assuming, from experience, that his work is coming out pitted with small indentations, and also with a nasty grey skin. The indentations are caused by the coal dust used in the facing sand being much too coarse, and this should be immediately attended to. The greyness of skin is caused by using too much new sand in the making of the facing sand.

A coal dust of not less than 90 mesh, that is, a coal dust that has passed through a mesh of 90 to the sq. in., should be obtained, and this in conjunction with a reduction of new sand should give the required sand for use against the patterns.

A light dusting of plumbago through a fine bag on to the mould and quickly blown off will add to the beauty of the skin of the castings. A suitable mixture of sand for the work of such section as is mentioned would be: Eight parts of old sand; one part of new Stourbridge sand; and one part of coal dust, prepared as mentioned.

In conclusion "Electrical" should remember that it will probably take some time to "work out" the coarse coal dust that has been used previously, and until this has been done he will be troubled by "pitting in" mentioned. If he has no opportunity of changing his sand in its entirety, he would be well advised to obtain a small supply from another "light" foundry to use with his facing material until such time as his old sand has "worked back" into condition.

As a final note, "Electrical" should see that all the ingredients mentioned are used very dry, well mixed, and then passed through a fine sieve — 8 mesh to 1 in. The necessary damping can then be done prior to final mixing.

Yours, etc.,

G. C. P.

London Branch, I.B.F.

Replies have also been given by Mr. Rex Lambert, Messrs. W. Canning & Company, and Mr. J. H. List.

Book Review.

The Chemical Colouring of Metals and Allied Processes, by Samuel Field, A.R.C., Sc., London, and Samuel R. Bonney. Published by Messrs. Chapman & Hall, Limited, 11, Henrietta Street, Covent Garden, London, W.C.2. Price 10s. 6d. net.

The subject of colouring metals is but poorly represented in technical literature, and there is good scope for a book of this character for use amongst foundrymen.

The first two chapters are devoted to elementary chemistry, and whilst constituting a useful inclusion, the matter contained is to be found elsewhere. The third chapter deals with the action of air on metals, the influence being neatly summed up in a final table. The general methods of colouring are outlined in Chapter IV, and in the following two sections a practical discourse on the mechanical and chemical cleaning of metals is given. Then follow chapters on lacquering; electro deposition; the colouring of copper; brass; silver; gold; zinc; nickel; iron; tin and aluminium. The last two chapters outline a number of diverse processes, including much useful information on repairing work. The book contains over 260 pages and 14 illustrations, and is well indexed. There are several minor points which we do not appreciate. For instance, we see no reason why, after devoting two chapters to chemistry, the authors should refer to hydrochloric and sulphuric acids, as muriatic acid and oil of vitriol. Whilst one does not expect literary excellence in technical books of this character, there are places where the text could be made to look a little less like a student's note-book by the incorporation of an occasional definite article. However, these minor details in no way detract from the general usefulness of the book.

Works of Llanelly Foundry and Engineering Company, Limited.

The works of the Llanelly Foundry & Engineering Company, Limited, situated on the Pembrey Road, about one mile from Llanelly, were laid down particularly for the production of chilled and grain rolls and part-chilled and grain rolls, ingot moulds, and general iron castings, these last being produced in weights up to 40 tons. There is also a non-ferrous foundry in which phosphor-bronze, gunmetal, and other alloy castings are made up to 12 cwts. The site acquired by the Company, some 15 acres in extent, is very conveniently situated, as the sidings connect up directly with the main line of the G.W.R., and it is, of course, in the heart of the South Wales sheet and tinplate industry. The whole of the ground, marsh land, had to be made up for the erection of the works, and the land at present uncovered will furnish a convenient tip for works ashes, etc., for many years to come.

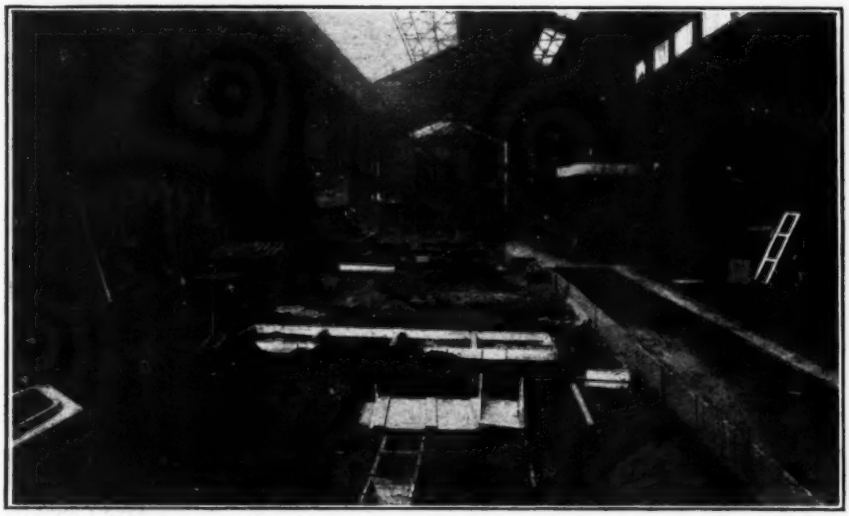

Fig. 1.—View in Foundry looking towards Ingot-mould Bay.

The sidings extend completely round the works, and the stocking ground along one side of the foundry. The sidings are furnished with a Pooley 25-ton weighbridge, and the stocking ground is served by a Booth 7-ton Goliath crane 45-ft. span. This crane carries a Phœnix magnet, the arrangement being such that trucks can be discharged on to the stocking ground, from that ground, or direct from trucks, to the cupola charging platforms.

The foundry building is 390 ft. long × 65 ft. × 38 ft. high to the eaves. The floor is served by two Vaughan electric cranes (a 25-ton and a 15-ton) and a 3-ton Vaughan electric trolley hoist, the main duty of this last being delivery of the moulding sand to the various parts of the foundry. The sand plant consists of two pan mills, together with elevator and disintegrator, the whole being driven by a 15-h.p. motor.

For all practical purposes the foundry floor is divided into three portions, devoted respectively to ingot moulds (of which the output is about 40 tons per day), general engineering castings, and roll casting, the capacity for this last portion being 70 to 80 tons per week.

Fig. 2.—View in Roll-Casting Bay.

The melting plant consists of three cupolas of 15 tons per hour capacity, one of 5 tons per hour, and one of 1 ton per hour—the last being used for feeding and special purposes—and three air furnaces of 15 tons, 7 tons, and 5 tons capacity respectively. The main cupolas are placed in two pairs, and are blown by Keith-Blackman fans driven by 50-h.p. motors; these fans are installed in duplicate, either fan being capable of blowing

both cupolas, or either cupola as may be required. The small cupola is blown by a Turbon fan.

As already stated, the charging platforms are served by the Goliath crane; the platforms themselves, however, are of very liberal dimensions, that for the larger cupolas providing storage for 200 tons of material. The 15-ton air furnace has a stack 80 ft. high × 3 ft. 3 in. internal diameter, and the other two air-furnace stacks are 65 ft. high × 2 ft. 6 in. internal diameter.

Moulds for the ingots are made in a pit on a Mumford jolt ramming machine, which will take

FIG. 3.—VIEW IN ROLL-TURNING SHOP; LLANELLY FOUNDRY AND ENGINEERING COMPANY.

moulds and boxes up to 4 tons in weight. This pit is served by an electric jib crane mounted on a turntable base; it is thus also available for service in the ingot-mould-casting pit, which adjoins.

Of the work passing through the general foundry at the time of our representative's visit mention may be made of a housing for a bar mill, 21 tons in weight. In South Wales cold-blast iron castings are finding more favour than steel castings for mill housings.

The roll-casting floor is equipped with three pits respectively 22 ft. deep × 10 ft. square, 12 ft. deep × 10 ft. square, and 6 ft. deep × 26 ft. × 8 ft. There are four stoves, each 18 ft. × 13 ft. 6 in. × 10 ft.; they are coal-fired, and the bogies are charged by the shop crane and a snatch block. There is a further small coal-fired furnace for warming the chills.

The non-ferrous melting plant, which is housed in an annexe of the main foundry, consists of a 500-lb. M.R.V. tilting furnace and three 500-lb. pot furnaces.

The machine shop is parallel with the foundry, and is covered by one bay 210 ft. × 65 ft., with ample north lighting, the floor being served by a Vaughan 15-ton crane. The shop is arranged in two main portions for roll turning and general machining respectively, whilst a portion at the end of the last-mentioned is laid off as a works sub-station.

From the foundry there is rail communication with the roll-turning shop. This last is equipped with 12 lathes, disposed 6 on either side. Each group of lathes is driven from a line of shaft, which in turn is driven by a 40-h.p. motor, the drive from shaft to lathe in each instance being by friction clutch.

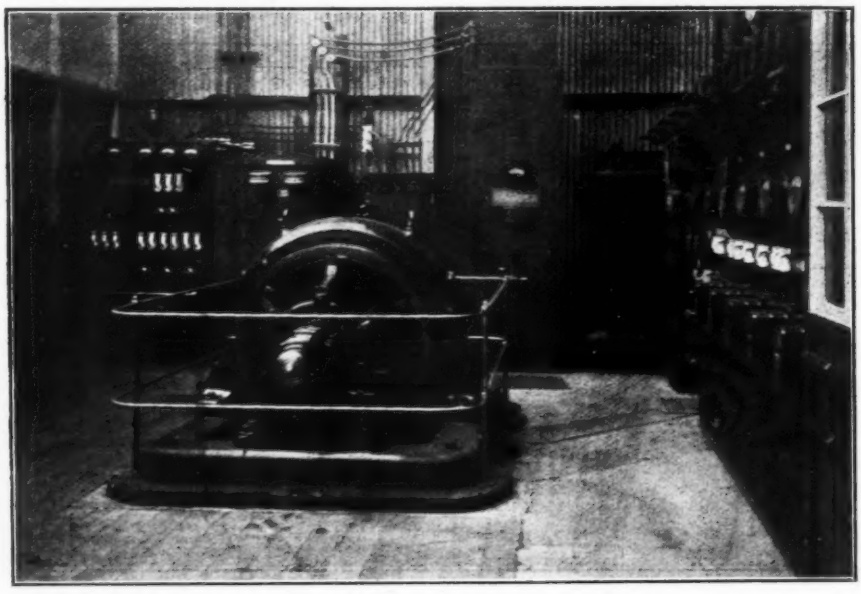

FIG. 4.—WORKS SUB-STATION, LLANELLY FOUNDRY AND ENGINEERING COMPANY.

The machine shop houses some remarkably fine tools, and the complete equipment is essentially up to date. Independent electric drives are applied to each of the heavy machines. Among the special tools mention may be made of a Butler 21-in. slotter; two Shanks all-geared head lathes, 21-in. centre × 24 ft. bed; Harvey all-geared head lathe, 24-in. centre × 25-ft. bed; Dean, Smith &

Grace 16-in. centre all-geared head lathe × 25-ft. bed; Stirk planer, 5 ft. × 5 ft. × 16 ft., which is fitted with the Lancashire Dynamo Company's drive; Cincinatti-Bickford radial drill, 5 ft. radius, and a range of grinding machinery.

The smiths' shop is served by a 10-cwt. Massey electric pneumatic hammer and manual jib crane. The smiths' fires are blown by a Turbon fan. In the pattern shop, which adjoins the smiths' shop, there is the usual range of saws, planers, sanders, etc. The laboratory building has just been completed, and the equipment is well advanced.

Current is taken from the mains of the Llanelly Power Company at 12,000 volts and stepped down in the works sub-station to 220 volts. D.C. current for the cranes, etc., is supplied by a G.E.C. 250-kw. rotary converter. In the sub-station is also installed an Ingersoll-Rand 500-cub. ft. compressor for supplying power to the jolt rams.

The buildings have been erected with a view to their future extension from either or both ends. At the present time a portion of the unoccupied ground is being levelled up for the erection of a pattern stores, 100 ft. × 30 ft.

The Selling of Castings.—IX.

By VOYAGEUR.

The efficient advertising of castings must follow four fundamental principles. Glancing through the pages of advertisements published by founders one finds that the majority of them consist of "business-card" advertisements, or, in other words, a mere enunciation in big black letters of the name of the advertiser, and of the products that he manufactures. This would be all very well for such commodities as soap and toothpaste, where simple repetition of a name is enough to set the mind-process working that results in a sale. But it is far more difficult to sell castings by advertisement than to sell soap, simply because one cannot appeal to the emotions. One has to appeal by reason and argument. The trouble with the "business-card" advertisement is that it is unattractive, lacking in interest for the reader, and inefficient as a means of getting business. If a buyer has authority to purchase a few dozen tons of locomotive castings, he does not want to know merely the name of the folk who make these. He wants to know the modernity of their plant, their power of giving him steady or quick deliveries, their geographical position, the quality of the material they use, the technical expertness of their production staff, the tests their castings will give, and so forth. The business card tells him nothing of this. A salesman who walked into an office and shouted "Blank's castings!" at the top of his voice would not get many orders. Yet an advertisement that does precisely the same thing is expected to bring results. It will not.

An advertisement of castings must show the purchaser or user with extreme clarity why those particular castings are worth ordering; why they are more worth ordering than any others; and how they can be had. It is not sufficient merely to say that they are worth ordering. Proof must be brought.

These preliminary remarks lead to an enunciation of the first fundamental of good casting advertising: *the efficient advertisement of castings must indicate, as fully and practically as possible, with no exaggerated phraseology or ridiculous over-praise, the different ways in which the castings discussed are superior to or different from others on the market.*

To do this properly, the competing castings should be ignored. From the advertiser's point of view, one might say, no other castings exist. The moment the founder says, "My castings are the best," he admits the existence of others, and makes the buyer anxious to find out who these other founders are. Remove from the casting advertisement any mention of competing makes or materials. In efficient advertising, all the space available is needed to explain completely the merits of the castings themselves.

The next fundamental principle is to *rely solely upon facts.* Unless an advertisement contains plenty of recognisable and definitive facts, it lacks grip and interest. Facts always strengthen the appeal of an announcement. "Seventy-nine men killed in a London storm" is a much more striking headline than "Many deaths in a storm." The former tells the reader something specific, and rivets his attention. It is much better, similarly, for the founder to say, "Blank's steel castings at a recent test gave 39 tons tensile strength per sq. in.," than for him to declare, "Blank's steel castings give excellent results when tested." The first statement leaves a definite impression on the reader's mind. If a buyer, he begins to ask himself, consciously or subconsciously: "Isn't that just the sort of result I want my castings to give? Ought not I to give those people a trial?" The actual facts presented carry with them a conviction of straightforwardness and genuineness. The second statement, on the other hand, does not make the buyer think. It tells him practically nothing. It does not challenge him to make comparisons with the castings he is at present buying.

In the same way, hackneyed phrases should be cut out of all advertisements—*e.g.*, "Save money by using," "For reliability, accuracy and economy," "Castings of quality," "Reduce costs with Blank castings," and so on.

The third fundamental principle is that *the founder's opinion of his own castings does not convince a buyer who has ordinary commonsense.* However harsh the dictum may sound, it is perfectly true that the founder is necessarily an interested party in selling his own products. Therefore, thinks the buyer, so much has to be discounted from his published opinions. Even though he may be a perfectly sincere and honest man, believing his goods to be the best in the world, he cannot help being a little kinder to his own castings than an independent inquirer might be. When, therefore, a founder makes the bold statement that his castings are "the finest in the world," the buyer merely smiles and passes on. He knows that there speaks bias, and he has not the time to challenge claims so extravagant. He waits till he finds an advertisement that tells him facts about castings of a particular make—facts that are not merely the manufacturer's own expressions of opinion; facts that can be proved or would not otherwise be published. What sort of facts? is a query that may readily arise at this stage. The full answer must be left to a later article; but one may indicate briefly such facts as *actual users* of the castings, *actual figures* of length of life in use, *actual test reports*, etc., etc.

The fourth and last fundamental principle is to *take into account the idiosyncrasies and needs of the special market the advertisement is intended to reach.* In this respect one finds much greater method among American manufacturers than at home. It is by no means an uncommon thing to see one advertisement doing duty for an English founder in every country in which he advertises, quite regardless of the special needs that sometimes make that advertisement wholly unsuitable for a particular district or country. Thus, in China, castings are bought in a manner very different from that which regulates their purchase in India or South America or England. Similarly, it is useless to do as one founder did some time ago, publish in a Siamese newspaper an advertisement to the effect that where mass-production methods were in force, his castings were ideal. Obviously, Siam is not a country in which mass-production is in force, and to talk in this way was merely to be publicly ridiculous. The point was that through laziness or carelessness, or both, this advertisement had been scattered broadcast for publication in every journal in which space was taken, no attempt being made to ensure its suitability for each.

Up to now the writer has confined himself to the broad general principles of advertising as a factor in selling castings. It was necessary to clear the ground in this way, so that future articles could deal with the subject more specifically.

MR. T. E. DODDS has been appointed head of the Engineering Department of the Municipal Technical School, Birmingham (rendered vacant by the death of Mr. T. Reid). Mr. Dodds has been for three and a half years head of the Mechanical and Civil Engineering Department of the Sunderland Technical College.

The Inspection of Castings.

By W. J. Hiscox.

It is important that every casting should be thoroughly examined by a competent man before leaving the foundry. It is true that inspection is accepted as an integral part of the organisation in many foundries, but even where this is the case too many defective castings are being released, this being due to the fact that the examination is but cursory.

The importance of castings inspection is more fully appreciated by the engineer whose factory includes a foundry, and as a result the number of castings rejected for visible defects after leaving the foundry is practically nil. The engineer recognises that much valuable time can be lost in the machining department owing to defective castings, and he therefore insists upon the rigid inspection of all castings before they are released for further operations.

The inspectors attached to the machining department are concerned with machining operations, and not with the material, unless, as a result of machining, a defect is revealed. All material (including castings) is inspected prior to acceptance into stock, and the fact that the material is obtainable from the store should be proof that it is free from defect, and can be operated upon without further examination.

The engineer who buys his castings from an outside foundry must, however, examine such castings before acceptance, and although it is not the contention of the writer that this should be unnecessary, it is his contention that the founder should not allow the fact that the castings are inspected by the purchaser to regard inspection at his end as superfluous. Rather, it should be the other way about, and the foundry inspection should be more keen than that of the purchaser.

The writer's experience is that practically every consignment of any magnitude from some foundries contains castings which are obviously defective, by reason of blowholes, cracks, and breakages, as well as castings which, though perfectly sound, are in a dirty condition. In regard to breakages, it may be urged that these more often occur during transit, and that the founder cannot be held responsible. This is largely correct, but these breakages occur even when delivery is made by the founder's own van. Much of this is due to careless loading, and could be reduced considerably were the castings finally examined just prior to loading, and the loading itself adequately supervised.

Dirty castings reflect no credit upon the founder, and even the cheapest of castings are worthy of a "finish." In many foundries the "finishing" or "fettling" section is understaffed, and the result is that the men are overworked. Added to this, the rates are on the low side, and in order to earn "bonus" the work is scamped. The firm may consider this an effective way of speeding up output, but its reputation suffers. The firm may protest that more money cannot be spent upon labour in the finishing section, but this is neither desirable nor necessary. The firm should study the mechanical aids, and utilise these wherever possible. The result will be a saving in time and labour, and the finish of the product will be materially improved.

Some founders justify themselves by laying the blame upon the customer. The latter is at fault because (1) he will not pay a reasonable price for the casting, or (2) he will insist upon having quick deliveries. A few minutes' thought will prove that these points do not justify the attitude of the founder, as the following will show:—

(1) The price may be too low to warrant the production of a first-grade casting, but it ought to cover the production of a casting that will satisfy the customer. This means that, before the quotation is given, the precise requirement of the customer has been studied and is well understood, so that the price quoted will cover the cost of production (including overheads), together with a fair margin of profit. If, to secure the order, it is necessary to "cut" the price, the only "cutting" that can be permitted reduces the margin of profit but does not interfere with working expenses.

Now, the position is clear. The founder has accepted the order at a low margin of profit, and he has no right to endeavour to increase that profit at the expense of the product. He has the right, of course, to reduce his working expenses, so long as the customer's requirement is not prejudiced, and this can be accomplished only by improved methods in respect to production or administration.

He must not endeavour to "cut" manufacturing costs by a crude "speeding up," which results in the standard of the product being determined by the man, owing to lack of supervision and inspection. If he does this, he will gain the reputation of being a producer of indifferent castings, and the only orders that he will get will be those secured by undercutting his competitors, which ultimately will wipe out the profit margin and force him to depend wholly and solely upon what he can "save" in connection with manufacture.

Apart from this, he has to bear in mind that the customer will insist upon faulty castings being replaced free of charge, so that additional expense is incurred. Far better to do the job right in the first instance than to run the risk of having to make replace castings gratis.

(2) When a customer insists upon a speedy delivery, this does not mean that he is prepared to accept any rubbish, so long as it arrives upon the date specified. The customer may feel pleased at the promptitude displayed, but his pleasure is turned to wrath when he finds he has been landed with a "dud" casting, and that several days must elapse before a replacement can be made.

It does not necessarily follow that speedy delivery affects the quality of the casting, but when faulty castings have been despatched, the founder has no right to lay the blame upon the customer because of his insistence for a speedy delivery. The excuse is palpably shallow, and reveals the methods of the founder in a very bad light. If he quotes a delivery date, he should know that there is a reasonable chance of this date being met, and if adverse circumstances arise, delivery had better be extended for a day or two than to scamp the work and run the risk of its being rejected.

From the foregoing it will be appreciated that neither price nor delivery justifies the founder in sending out bad castings; that is to say, castings with visible defects. Every casting, no matter at what price quoted, should be examined by a competent man before leaving the foundry, and should a casting be returned from the customer for an obvious fault, this man should be censured.

For the inspection of castings to be really effective—which means reducing scrap work to a minimum—it should be handled in at least three phases, viz., (1) as soon as practicable after casting, (2) immediately after finishing and just prior to sending to the despatch room, and (3) whilst the castings are being loaded for despatch. The first inspection reveals faulty workmanship, and the man responsible for it; the second reveals physical defects in the finished product; whilst the third ensures that all castings leave the despatch room in good condition and free from visible fault.

If it be objected that this method of inspection would involve a good deal of expense, the writer would remark that, in the average foundry, one inspector could carry out the whole of the duties outlined. After all, a superficial inspection of castings is not a lengthy process, and the different phases occur at intervals that will permit of the inspector's duties being planned to cover the whole day. It will be found that the intervention of the inspector will not materially increase the time that elapses between the actual cast and the despatch of the finished castings, unless, of course, there is an abnormal percentage of rejections, and it is to obviate this that an inspector is appointed. In regard to the "finish," the inspector is not necessarily bound to reject all the castings that fail to win his approval. He should know the recognised standard, and do all possible to ensure it, but he must use discretion. He may, in certain instances, pass castings that are somewhat below the standard, but he sends a report to the foundry manager, this with a view to ensuring that the appearance of the next batch will show an improvement.

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Institute of British Foundrymen.

NEWCASTLE JUNIOR SECTION.

R. and W. Hawthorn, Leslie & Co.'s Works Visited.

About 80 members of the Junior Section of the Newcastle Branch of the Institute of British Foundrymen and their friends spent an instructive afternoon at the St. Peter's Works of Messrs. R. & W. Hawthorn, Leslie & Company, Limited, Newcastle-on-Tyne, on February 14.

The visitors were welcomed, on behalf of the company, by Mr. A. Logan (Chief Chemist).

These works cover an area of about 20 acres, and have a river frontage of 3,000 ft. At this branch, the marine engines are constructed both for the ships which the firm builds at its Hebburn Shipyard, and for other leading shipbuilders, whilst a third branch of the firm, at Forth Banks, is devoted entirely to the manufacture of all types of locomotives.

The foundations of the present firm were laid in 1817, and, according to the records, the first marine engine made was a small set of only 7 horse power. Since then, the history of the firm has been one of continual progress, and a world-wide reputation has been built up.

FIG. 1.—THE FOUNDRY, ST. PETER'S WORKS, NEWCASTLE-ON-TYNE.

The firm is well-equipped for the construction of all kinds of reciprocating machinery, turbines, and internal combustion engines, having a capacity at their St. Peter's Works of 200,000 h.p. of machinery per annum.

The principal departments at the marine engine works, in addition to the main offices, are: A fitting shop, erecting shop, turbine blading shop, large and small machine shops, boiler shop, gauge and tool shop, valve shop, copper shop, blacksmith's shop, pattern shop, foundry and laboratory.

The workshops are electrically driven throughout, and are laid out in such a way as to ensure the work passing through in proper sequence so that the whole may finally gravitate to the erecting shop.

Erecting Shop.

In this shop the visitors saw a very large set of twin-screw quadruple reciprocating engines for the P. & O. liner T.S.S. *Ranchi*, which is a sister ship to the T.S.S. *Ranpura* (now complete and ready for service between London and Bombay). Some indication of the size of these engines can be gathered from the fact that the L.P. cylinder is of 96-in. bore. The engines are 46 ft. long, 33 ft. high, and weigh 450 tons each, the set having a total weight of 900 tons. The total horse power at 90 revolutions will be 15,000, and the vessel is to do 17 knots.

In marked contrast to these engines, was to be seen a set of twin-screw quadruple reciprocating engines for a gunboat built to the order of the Siamese Government. These engines are only 10 ft. high, and 11 ft. long, and weigh only 20 tons.

Recently, there has been organised a special technical department to supervise the design and manufacture of internal combustion engines; for which class of work special machinery and equipment, including a large Heenen and Froude dynamometer, has been installed.

On the test-bed in the erecting shop there was at the time of the visit a twin set of Hawthorn-Werkspoor diesel engines, fitted with recording apparatus which has enabled extensive trials to be carried out, and valuable data obtained.

Prior to, and during the War, the firm was almost fully engaged upon Admiralty work, but since 1918 many high-class vessels have been engined for such lines as the Cunard, Holt, P. & O., B. I., Commonwealth and Dominion, Tyne and Tees, etc.

The firm has under construction a set of water-tube boilers and turbine machinery for one of the five 10,000-ton cruisers now being built. Marine boilers of all types are also manufactured at these works.

The pattern shop, laboratory, foundry, and cleaning shop are situated at the west end of the works.

Pattern Shop.

This is a large, well-lighted modern building, consisting of two bays, the larger being 150 ft. long by 50 ft. wide, and the other 100 ft. long by 55 ft. wide. The handling of large work is facilitated by an overhead crane of 3-tons lifting capacity.

Amongst the more notable of the up-to-date equipment are: Circular saws, band saws, twin band saw, band saw sharpening machine, thicknessing machines, surface planing machines, lathes, sandpapering machine, emery grinders and a Wadkins mechanical wood worker.

XUM

Each machine is fitted with a connection to a central suction dust extractor, which effectually disposes of all sawdust and shavings.

The Foundry.

In this building (Fig. 1), the main bay of which is 200 ft. long and 40 ft. wide, brass, whitemetal and cast iron work is turned out. The shop is served with two overhead cranes, and the machinery installed includes a magnetic separator, ash washing plant, sand mill, fan blowers for cupolas, etc.

The furnaces for brass melting, of which there are twelve, are of the pit-fire type, taking up to 600-lb. crucibles. There is also a 400-lb. forced draught Morgan tilting furnace, and a reverbatory furnace capable of melting from 5 to 7 tons. A speciality of the firm is the manufacture of manganese brass propellers and loose blades, one of which is shown in Fig. 2.

For cast iron, there are two Jackman drop-bottom cupolas, one melting 5 tons and the other 3 tons per hour.

Cleaning Shop.

This shop adjoins the foundry, and is equipped with overhead cranes, emery grinders, sprue cutter and pneumatic tools. There is, in addition, a special grinder for dealing with propellers and blades.

Laboratory.

The foundry is run in collaboration with the laboratory, which is a separate building compris-

Fig. 2.—A Manganese Brass Propeller, St. Peter's Works, Newcastle-on-Tyne.

ing a main analytical laboratory, balance and sample room, combustion room, micro-room, and office. Besides testing foundry materials, it is equipped with apparatus for physical testing, general analysis, electrolytic analysis, gas analysis, oil testing, photo-micrography, etc. Special apparatus has also been designed, and is in use for turbine blading experiments. The micro-room is equipped with a Watson microscope, which can be used for both visual and photographic work.

After each department had been inspected, the visitors were entertained to tea by the firm, at the conclusion of which the President of the Junior Section (Mr. E. J. Rang, B.Sc.) proposed a hearty vote of thanks to Messrs. Hawthorn, Leslie & Company, for their kind hospitality. Mr. Logan replied on behalf of the company.

Origin of Some Foundry Materials.

In the evening a meeting was held in the Y.M.C.A. Buildings, Newcastle, when Mr. C. Boudry read a Paper on "The Origin and Chemistry of some Foundry Materials," Mr. E. J. Rang presiding.

The lecturer very carefully described the formation of sand, passing on to the composition and properties of moulding sand. The bond of a moulding sand depended, he said, upon the quantity and quality of clay in the loam added. Too much clay must not be used as, when heated in contact with molten iron, it baked hard, and, consequently, prevented the escape of gases from the mould. Erith loam had won a name for itself in the foundry world as being suitable in regard to bond and refractoriness. The speaker explained that ground sea coal was usually added to moulding sand, in order to increase the permeability. The grain-size of the sand played, of course, an important part in the problem of permeability, the more uniform the grains the greater being the permeability.

Besides bond and permeability, it must be able to withstand the temperature of the iron, and, therefore, the ideal moulding sand would be one of pure quartz grains, free from felspars, and mixed with the least possible amount of a refractory clay to give it the requisite bond.

For cores and portions of a mould which required exceptional venting properties with, at the same time, greater bond, core oils and core gums, etc., were used.

Passing on to the question of iron ore, the lecturer stated that iron carbonate was appreciably soluble in water containing carbon dioxide and that iron was transferred from place to place in nature chiefly by this agent. If the water was exposed to air, however, oxygen was absorbed and the iron was thrown down as brown rust, such as was often noticed on the beds and sides of rivers running through iron bearing districts.

It was seldom that iron ores were met with in the pure state, and the practical use of an ore depended upon the nature of the impurities which it contained, the mechanical conditions of the ore and its accessibility.

He described the conversion of iron ores into pig-iron, in the blast furnace, touching upon the chemical reactions which took place during melting. It was pointed out that by a comparatively slight alteration of its constituents, cast iron of very different properties could be produced.

In conclusion, the lecturer touched upon the requirements of firebrick, mentioning that its texture determined its usefulness in certain cases.

There was an interesting discussion, in which the President, and Messrs. W. P. Gospel, L. B. Chapman, F. C. Spencer and C. R. Van der Ben took part.

Illustrated Technical Dictionaries.

Many of our readers will already be familiar with the earlier volumes of the Schlomann-Oldenbourg Illustrated Technical Dictionaries in English, French, German, Italian, Russian and Spanish, which were begun some years ago.

It is of interest to note that a British Office has now been opened, Mr. H. I. Lewenz, M.I.Mech.E., M.I.E.E., has been appointed Editor and Manager for the British Section, and will in future be responsible for the English terms and phrases contained in the dictionaries. Since the war, which naturally interrupted the work, volumes XII, XIII, XIV and XV have been produced. They deal respectively with the following subjects:—Hydraulics, Pneumatics and Refrigeration; Building Construction; Raw Materials of the Textile Industry; and Spinning—Its Processes and Products.

These will be followed shortly by a volume on Weaving and Woven Materials, one on Mining, and later by volumes on Agricultural Machinery, Chemistry, Gas Engineering, etc. All the earlier volumes, commencing with Electrical Engineering, will be revised in the light of experience gained and knowledge afforded by the kindly criticisms of many readers.

The work was issued and stocked by Messrs. Lewenz & Wilkinson, Limited, 25, Victoria Street Westminster, S.W.1.

The shareholders of Light Steelwork, Limited, have decided that the company be wound up voluntarily, with Mr. M. C. Spencer, of Price, Waterhouse & Company, 3, Frederick's Place, Old Jewry, London, E.C., as liquidator.

Mr. E. Harland Hutchinson has received an executive position with Vickers and International Combustion Engineering, Limited, of Africa House, Kingsway, W.C.2. He will have charge of the firm's interests in the Dominions and Colonies, and is shortly proceeding to Australia, via U.S.A. and Canada.

Brazing or the Jointing of Metals by Means of Non-ferrous Alloys.*

[ABRIDGED.]

By A. R. Page (Birmingham).

INTRODUCTION.

The problem of the jointing of metals by means of non-ferrous alloys is of very great industrial importance in this country, especially to manufacturers of turbine blades, bicycles, motor bicycles and automobiles, and is also of great interest to both the ferrous and the non-ferrous metallurgist; to the former because in the majority of cases the materials to be joined consist of iron and steel, and to the latter because the jointing medium is invariably some non-ferrous alloy or other. It was thought, therefore, that a Paper describing the processes involved, together with the materials used, although partly of interest to the ferrous side of the industry, should be presented before the Institute of Metals, since it is for the non-ferrous metallurgist to devise the suitable alloys which will help the ferrous metallurgist to obviate some of his trouble in order to produce an improved article. At the same time, suggestions will be made as to the lines on which the non-ferrous metallurgist can work in order to make the process more satisfactory. In this Paper electic welding or acetylene welding is not dealt with, as the processes are of no great interest to the non-ferrous metallurgist.

There appear to be three distinct methods of joining by means of a second material, as it may be termed, though the three methods are common in certain respects. They may be classified as follows:—(1) Brazing; (2) Hyde welding, and (3) soldering.

In the first two cases, the method consists in cleaning the components by sand-blasting and filing, and then applying to the joint the jointing material which is then caused to fill up the joint by the application of heat. In the three processes, however, different materials are used, and the method of application of the jointing material differs somewhat also.

For brazing, the alloys used are usually those of copper and zinc, the alloy in most general use being one containing about 50 to 55 per cent. copper and 45 to 50 per cent. zinc.

Two distinct methods are in use at present for brazing iron and steel (*a*) the blowpipe method and (*b*) the dip brazing method.

Blowpipe Brazing.

The technique of this method consists in pinning together the two articles to be jointed. The joint is then heated up in a blowpipe, of the ordinary design, town's gas or producer gas being used together with compressed air. Under the articles to be brazed is a small bath of molten brass covered with a layer of fused flux, for example, borax.

The brazing solder, as it is called, is usually bought in a granulated form to facilitate ease and celerity in melting, and as soon as the joint is hot enough, the molten brass, mixed up with molten borax, is poured on in small quantities over and round the joint by means of a small ladle. In this way, the molten brass flows through the interstices of the joint, the function of the borax being to keep the surfaces to be jointed free from dirt and oxide, which is supposed to be dissolved in the flux. The clearance between the two surfaces is small, usually being a sliding fit, so it seems that the molten brass solder enters the interstices by capillarity. The joint is then allowed to cool down, is cleaned and filed and quite a sound joint will have been produced.

Dip Brazing.

Dip brazing differs from the blowpipe method, in that a bath of molten solder of some considerable size is used, so that the whole joint can be immersed. This process is only applicable to certain kinds of joints, for example, angle or end joints. Straight joints cannot be conveniently treated for obvious reasons.

The whole joint is placed in the liquid bath so that it is just immersed in the brazing metal, which is covered with a layer of fused flux. The lug itself and the tubes are painted over with a mixture of molasses and graphite, except just at the joints, to prevent the brazing solder from adhering to the steel or iron. The phenomenon of jointing is apparently similar to that in the blowpipe process. The solder flows by capillarity between the interstices of the lug and the tube, and forms a sound joint.

Hyde Welding.

The Hyde welding process is different from the brazing processes, in that pure copper is used as the jointing material. The operation consists briefly in placing the pieces to be joined in contact together with a piece of copper wire or strip adjacent to the join. The whole is then heated in a furnace up to the melting point of copper, and the molten copper flows into the interstices of the joint by capillary action, as is the case with the brazing process. The furnace is so designed, however, that an atmosphere of hydrogen is maintained therein, in order presumably to create a strongly reducing atmosphere, so that there is no likelihood of the copper or the steel becoming oxidised and producing a weak joint.

The Hyde welding process has its limitations, since it is not convenient to treat articles other than of moderate size. Furthermore, the furnace containing free hydrogen is somewhat dangerous, and excessive care has to be taken to avoid explosions.

GENERAL CONSIDERATION OF THE PROCESSES.

Effect of Temperature.

The effect of the temperature necessary to melt the jointing media is considerable where steel and iron articles are being brazed or welded. For example, it is necessary in the blowpipe or dip brazing method to attain a temperature of about 950 deg. C., to allow the brazing solder to run. This temperature naturally does the iron or steel no good, and in the author's opinion, is where the weakness of the process lies. Unfortunately, also, the temperature to which, say, a steel tube is heated is variable, as one gets further away from the joint, that is, it is hottest in the actual brazing zone, and the temperature drops rapidly down to normal some distance away from the joint. It is a significant fact, that in failures of brazed joints, it has been the author's experience that in most cases, fracture takes place in the tube, not at the joint itself, but some distance away, perhaps 1 in. Very rarely does one find that the actual joint has failed, even though this may, on examination, prove to be not quite sound.

Dip brazing seems to give more reliable results than blowpipe brazing, since the temperature conditions are more defined. It is usual to control the dip brazing bath by means of a thermo-electric pyrometer suitably protected.

The general practice is to work the bath in the neighbourhood of 975 deg. C. With both these methods of brazing, however, the effect of variation in the temperature along the length of the tube is considerable. Thus, the portion of the article containing the lug is at a temperature of about 975 deg. C., which temperature gradually drops to normal in a length of some 5 or 6 inches from the joint. As mentioned before, the weak point in the assembled unit seems to be about 1 in. from the actual joint; at any rate, that is where the majority of failures take place.

It is the practice in the trade to use for framework hard-drawn steel tubing. The author would venture to suggest that the explanation of the fracture at these points away from the joint is due to the critical temperature being reached at this point, which is just the correct condition for causing excessive grain growth in the cold-worked material.

* A Paper read before the North-East Coast Local Section of the Institute of Metals, Prof. H. Lewis, M.A., D.S.C., presiding.

In the Hyde welding process, the temperatures reached must be in the neighbourhood of the melting point of copper. The same conditions here, however, do not obtain as in the brazing processes, since the whole article is heated to that temperature, and consequently, one does not obtain that gradation in temperature effect which is noted in the brazing processes. The fact, however, that the steel material is heated to this temperature causes excessive crystal growth and consequently weakness.

Type of Joint.

There does not seem to be any evidence that there is even a superficial alloying of the brazing solder to the lug or the steel tube. The joint seems to be created by a simple sticking. In the Hyde welding process, however, there does seem to be a superficial alloying of the copper and the iron.

This is the second point which created a large amount of discussion. It was the opinion of the Birmingham meeting that there was every likelihood of alloying taking place, since it is well known that copper penetrates steel during electric welding and that alloying also takes place between zinc and steel in galvanising. It is reasonable to assume, therefore, that brass and steel will form a superficial alloy. It is certainly difficult to find this in ordinary brazed joints owing to the difficulty of polishing the joint really satisfactorily. It was the author's opinion that the brazing operation occupies so short a time (something like 15 minutes) that if alloying does take place, it is negligible for all practical purposes. Further work was therefore carried out, lengths of ½ in. dia. 0.30 per cent. carbon steel being immersed in a molten bath of brazing solder covered with borax, at 1,000 deg. C. for varying times from 15 minutes to 2 hours. The bars when cold were then sectioned up to see whether any penetration had taken place on the surface of the steel.

After cutting off the sections, a steel ring was forced on the short length of round bar and the whole section polished, in this way the treated bar was polished quite flat right up to the edge. The sections were then examined in the unetched state, but there did not seem to be any penetration of the brass, a clear line of demarcation being observed. The sections were then etched in nitric acid, but again showed no alloying or penetration, except after two hours' immersion, where there appeared to be some penetration of the brass, and consequently the section was repolished very lightly in order that the etching would just be removed. The section was then re-etched in dilute ammonia which attacked the brass. The white portion which had appeared to be brass was unattacked, and, therefore, must have been ferrite.

Composition of the Jointing Material.

In the brazing processes, the alloy most generally used for ordinary purposes has the following composition:—Copper, 50 to 55; zinc, 45 to 50; iron less than 0.5; lead less than 0.5 per cent., and tin, trace or nil.

In the dip-brazing process the composition of the bath seems to change, due to the slight volatilisation of the zinc, although it must be borne in mind that the bath is covered by a layer of fused flux, such as borax.

Some tests taken over a period of a few days show the percentage of copper to increase from 50 per cent. at the start to 61.2 per cent. The results also showed that the loss in zinc is more rapid at the commencement when working a new bath.

In the blowpipe-brazing process it seems that the composition of the jointing material in the joint is practically the same as that of the original alloy used. If anything, the copper may be slightly higher, due again to volatilisation of the zinc.

The iron content appears to increase slightly after continued use of the bath of metal, but this increase is slow, and it takes considerable time for it to reach 2.0 per cent.

Shearing Strength of the Joints.

The first data was obtained to discover the respective merits of blowpipe and dip-brazing. For this purpose steel rods were brazed into steel cylinders, allowing the usual clearance of about 2 to 3 thousandths. The inside rod was then placed under a compression machine, and the load required to cause the joint to give way was noted. Two series of tests in duplicate were carried on different sized units, and the results obtained were:—

First Joint.		Second Joint.	
Blowpipe.	Dip.	Blowpipe.	Dip.
3,680 lbs.	4,390 lbs.	7,020 lbs.	9,950 lbs.
2,580 lbs.	3,830 lbs.	7,975 lbs.	8,540 lbs.

These figures indicate that dip-brazing gives higher strengths of the joints than does blowpipe brazing. Unfortunately, at the time these tests were done, no records were taken of the dimensions of the test pieces, so it is impossible to calculate the actual strength of the joints per sq. inch of contact.

Further tests were carried out later, of exactly similar type. The internal diameter of the cylinders were 0.303 in., and the plunger was 0.297, leaving 3 thousands' clearance on either side. The results obtained were:—

	(*a*) ½" telescope.	(*b*) ¼" telescope.	(*c*) ¼" telescope.
Blowpipe	7,500 lbs.	3,680 lbs.	2,580 lbs.
Dip Brazing	9,245 lbs.	4,350 lbs.	3,830 lbs.

Assuming 0.300 in. as the diameter, the area of contact of the joints would be:—(*a*) 0.471; (*b*) 0.353, and (*c*) 0.236 sq. ins.

The ultimate shear strength of the joints, therefore, are in terms of tons per sq. in.:—

	(*a*)	(*b*)	(*c*)
Blowpipe ...	7.1	4.65	4.86
Dip Brazing	8.76	5.5	7.26

From these figures it will be seen that in this case also the results from dip-brazing are better than those from blowpipe brazing. The figures are somewhat variable, which is, however, what one may expect when the rough technique of the processes is considered.

Comparison Between Brazing and Hyde Welding.

Tests were carried out with a different type of test piece, although the shear strength has again been determined. The form of test piece consisted of a bolt and a plain holed nut which was joined to the end of the bolt by each of the two methods. The bolts and nuts were made of different dimensions, and the joints were cleaned up on a lathe before testing. A holder was made through which the bolt was threaded, and the free end of the bolt gripped in the one set of the jaws of the tensile machine. The holder was gripped by the top jaws of the machine.

In view of the fact that in a number of cases the bolts broke before the joint gave way, one can only say that in those cases the joint is greater than the breaking strength of the bolt. No definite figures as regards strength can be obtained.

The results given are very interesting, as they show that—(1) In many cases the strength of the joint is greater than the strength of the steel; (2) generally speaking, the shearing strength of the brazed joints are greater than those of the Hyde-welded joints. In only two cases did the brazed joints give way, the mean result being about 9 tons per sq. in. of contact. The strength of the Hyde-welded joints gave an average of 6.8 tons per sq. in. of contact; and (3) in subsequent tests, having obtained a general idea of the shearing strengths of the joints, the test pieces would be more suitably chosen to ensure the failure of the joint in preference to the steel bolt. In other words, the length of lap would be decreased.

Tensile Strength of Brazed Joints.

The following series of tests were carried out to determine approximately under works conditions of brazing the following:—(*a*) The actual strength of the brazed joint in tension, and (*b*) the effect of the brazing operation on the material brazed.

Two materials in the form of drawn tubing were used, these materials being those commonly used in the manufacture of bicycle or motor-bicycle frames. The respective carbon contents in the two materials were 0.31 and 0.12 per cent.

The results showed that the actual strength of good brazed joints in tension is in the neighbourhood of 13 to 15 tons per sq. in. The effect of the brazing operation on the strength of the tubing itself is to cause a considerable diminution in

strength which is to all intents and purposes equal to the decrease brought about by annealing. In one very important respect, however, the brazing operation produced a very different effect from that produced by the annealing process. The ductility of a tube subjected to the brazing operation is much less than a properly annealed tube, due to a large extent to the higher temperature essential to the former operation.

This last point is very important when one considers the materials, which are used in automobile engineering. Together with the steels containing about 0.15 and 0.35 per cent. carbon, a still higher carbon steel is used, viz., 0.5 per cent. while low and high carbon 1 to 3 per cent. nickel steels and nickel chrome steels are used for certain purposes.

With regard to the actual composition of the brazing solder, the material most commonly used is the brass containing 50 to 55 per cent. copper and 45 to 50 per cent. zinc, and generally speaking this gives satisfactory results in a very unsatisfactory process, but one which up to the present has not been superseded by any more satisfactory method. The use of other solders possessing similar melting points are not necessary because the factor of safety of the joint is far greater than really is necessary when one considers the strength of the component of the brazed unit.

It has been a very rare experience of the author to see a brazed joint itself fail. It is almost always one of the steel members which has fractured, even though the brazing has been so imperfect, as to leave blowholes in the joint.

Fluxes.

Very little seems to be known about the behaviour of the flux, although the use of a flux appears absolutely necessary in commercial practice. The flux almost universally used is borax, and its action is presumably one of solution of the oxides in the fused material. One flux recently investigated proved to have the following composition:—Na_2CO_3, 22.63; CaF_2, 22.81; SiO_2, 26.68; Fe_2O_3,Al_2O_3, etc., 9.42; MgO, 3.19; and H_2O, 15.10 per cent. It possessed no definite melting point, but became solid at 800 deg. C. It was found to be satisfactory, but was very difficult to remove from the joints after cooling.

DISCUSSION.

The Chairman (Prof. H. Louis), opening the discussion, said he was sure they would all agree with him that the Paper had proved very interesting and contained some valuable data. He mentioned that he himself had carried out some investigations on brazing, more especially in connection with wire ropes, and that he had found that the strength varied with the angle of the brazed joint. He then quoted a remark made by Prof. Huntington, some years ago, to the effect that the brazing process was unscientific.

The action of the flux in brazing was interesting from the purely chemical standpoint. Sal-ammonia or zinc chloride would probably be useful when the low melting-point solder, which Mr. Page had mentioned as being the ultimate ideal, was used.

Mr. H. J. Young, F.I.C., said the question of the penetration of copper and copper alloys into steel was interesting. He asked the author whether he had seen the several Papers, by the late Dr. J. E. Stead, which had been published upon the subject. In these Papers it was definitely stated that the presence of carbon in iron prevented penetration of copper and very possibly the opposite was the case also. Of course, it was well-known that the presence of a film of copper on iron or steel prevented cementation.

With regard to the question of fluxes, there were a number of quack mixtures on the market and a laboratory was very useful if only to investigate such. He mentioned one case of some "patent" mixture which consisted largely of borax and water and coloured a deep blue by ultramarine.

Mr. A. Crocker said that one trouble he had met with was the difficulty of getting rid of the borax after brazing. On cooling down, the borax appeared like glass, and he would like to ask the lecturer whether he had met with the same difficulty. Also he would like to know if Mr. Page had had any experience with the brazing solders; such as 70: 30 brass, which they themselves had found to give better results than the 60: 40 alloy.

Mr. E. S. Bettridge said that with the new method of blowpipe brazing mentioned by Mr. Page one possible objection might be the concentration of iron in the bath of solder. How did he counteract it?

Mr. W. G. Gibb said he had had difficulty in preventing the brazing solder from flowing on to parts of the work where it was undesirable, this necessitating extra cleaning. Could the author tell him how to obviate that trouble?

Dr. M. Cook said he was particularly interested in the grain growth of steel, but he did not think that Mr. Page had definitely proved his point from the photomicrographs shown on the screen.

Another interesting point was the question as to whether a superficial alloy was formed between the brass and the iron. He, personally, did not think that there was. He would like to ask whether, in the experiments described by the lecturer, any special precautions were taken to produce chemically clean surfaces of the steel parts before brazing. There was no doubt that this was a very important point.

THE AUTHOR'S REPLY.

With regard to the Chairman's remarks, he agreed with Prof. Huntington that the process was not at all scientific, his real object in writing the Paper being to impress the point that some new method of jointing was long overdue. He agreed that the angle of the joint was very important, as also was the design of the lug in frame building.

With regard to fluxes, mixtures of fluorides and borates unfortunately did not possess sufficiently low melting-points to be operated in the neighbourhood of 600 deg. C. Sal-ammonia and zinc chloride were too volatile at that temperature, although they were useful in soft soldering which, of course, was carried out at a much lower temperature.

With regard to Mr. Young's remarks, he had already apologised for talking so much about steel, but the question was really grain growth, and the Institute of Metals should be interested in this from the general point of view, forgetting for the moment that the metal under consideration was iron.

Undoubtedly the problem of brazing was a joint one, for the non-ferrous metallurgist to produce a jointing alloy, for the pure chemist to produce a flux and for the ferrous metallurgist because in many cases it was iron which had to be brazed.

Mr. Crocker had raised a very interesting point with regard to the removal of the solid borax after brazing. In the author's experience this was not a very serious difficulty since the borax could be removed by sand-blasting. He could realise the difficulty, however, when dealing with the brazing of turbine blades, etc., in which case sand-blasting, of course, would not be permissible.

In America a flux much used was borax, containing 5 to 10 per cent. common salt, and it was said that, on cooling, the flux cracked away. He suggested that Mr. Crocker might try this. He had had very little experience with 70: 30 brass as a solder, for the simple reason that he was trying to use a solder with the lowest melting-point possible in order to minimise the effect of overheating the steel members, and, of course, 70: 30 brass had a higher melting point than the 60: 40 alloy.

In reply to Mr. Bettridge, he pointed out that the bath of molten solder was only small, and, as new metal was continually being added, it was impossible for the iron content to reach a high figure.

With regard to Mr. Gibb's question, the use of molasses and graphite painted on the articles, except just at the joint, would prevent the solder from sticking at any undesirable point.

In reply to Dr. Cook's remarks, he agreed that the slides were not so satisfactory as he had wished, but he had proved to his own satisfaction that there was no low-temperature crystal growth in a brazed tube, and that fracture nearly always took place at the point of maximum high temperature grain growth. Dr. Cook had mentioned the presence of a dark line of demarcation between the iron and the brass, but he thought that this was due solely to shadow effect, which was very difficult to eliminate in the photographs.

He had not taken any special precautions to produce chemically clean surfaces before brazing, but this was a point he had intended to investigate.

XUM

An Analysis of Defective Castings.*

By E. Longden, A.M.I.Brit.F.

Founding is an art, and one cannot do otherwise than think that it will remain so for many, many years to come, and although much waste can still be saved, it will be impossible to eliminate scrap until this personal element is eliminated.

A story is told of a lawyer who was defending a moulder in an action for the recovery of wages stopped for making a waster that: "Making castings was like growing potatoes; no one could tell what they would be like, good, bad, or indifferent, until they were dug up."

There is much truth in such an explanation of the founder's lot. Watch the actions of the moulder when his casting is taken from the sand. He will scrape and tap his casting in various places, looking actually for that which he does not wish to find. If the casting is apparently sound he is relieved, but his anxiety is not ended, and perhaps during the dinner hour he may visit the machine shop to see his casting at some stage of the machining operations; if a little dirt is disclosed on an important surface he fearfully inquires from the machinist if there is not still a little more to machine off which would clean the surface. If the answer is in the affirmative, he returns to the foundry with lightened heart.

The subject dealt with is so vast that the author has concentrated his remarks on grey cast iron, but the majority of faults explained in this Paper would apply to all metals which are cast.

Cavities and Porosity due to Gases.

Without doubt, the greatest single cause of casting losses can be attributed to those embarrassing defects which are usually described as blow holes, liquid shrinkage cavities, and porosity, and which are thought in the case of grey iron to be due to gases generated in the mould and cores which may or may not combine or interact with gases occluded by the metal when cooling. Such defects are the more distressing because they are discovered, mainly, after machining and testing operations, and are especially dangerous when found in work of a high-class nature, such as internal combustion and steam engines, machine tools, pumps, turbine and hydraulic machinery, etc.

Foundrymen would be astonished if they knew how near sometimes they are to a scrap casting. For instance, a hydraulic cylinder which was broken up after many years' service showed a deep, irregular blow hole about ⅜ in. round, almost cutting through the section of 3 in., leaving only ¼ in. of sound iron, yet it had stood the wear and pressure until rejected for some other reason.

Gas cavities and porosity occurs in many ways, the chief causes being:—Insufficiently-dried cores and moulds when dry-sand and loam moulding is attempted; excessively hard-rammed cores and moulds; in some instances lack of ramming locally, because a pocket of loosely-rammed sand provides an easy exit for the gases generated in the harder surrounding sand, so that the gas easily flows forward into the mould cavity and metal; abuse of the swab locally, or too much moisture in the sand generally, especially when green-sand moulding; lack of the natural venting properties of moulding sand; omitting artificial venting; improper use of the vent wire, because, if probed deeply, it will be found that quite an appreciable percentage of blow holes are due to the over-sharp vent wire which is so often thrust through the sand and penetrates the pattern, the fine holes so formed are easily passed over by the moulder, and when the metal enters the mould the generating gases blow through into the mould cavity and, later, the metal; incorrect sand mixtures for the particular type of casting; faulty sand mixing; faulty and wrong mixtures of mould dressing; allowing metal to penetrate subsidiary and main vents in core or mould; choking of vents by sand due to unskilful manipulation; blow holes from inserted solid metal which has not received correct treatment, such as denseners, chills, nails, studs or chaplets; also these pieces of metal, in spite of much care, attract and condense steam created in a green sand mould in which has been placed a warm core, or from an imperfectly dried mould closed warm, and then allowed to stand so that it cools before receiving the metal; blow holes from wet loam stamps, which are placed on cores to make up the common errors in size between core and mould print; absence of openings or risers for exhausting mould gases quickly, particularly in confined sections of the mould, and especially if the nature of casting compels rapid pouring; insufficient fluid head pressure; escape of metal from mould, with the consequent arrest or ebb and flow of the molten iron; incorrect gating, so that metal enters mould wildly, or too slowly, perhaps the metal enters and impinges on mould or cores eddying and churning, so that air and other gases are mechanically mixed with the metal, or it may be that the gate is so concentrated on one portion that sand becomes overheated and the gases escape from the mould face into the metal rather than through the back sand, which has become unduly overburdened with gas generated at very high pressure—it may be that metal has such a tortuous passage, due perhaps to wrong location or insufficient git, that it becomes lifeless and unable to expel collected gases, for it might be said that the very act of pouring tends to create blow holes because of agitation; omitting to feed metal through riser gates to replace escaping gases and badly located feeders; dull iron, because there is always much more difficulty in obtaining castings free from blow holes when the moulds are poured with sluggish iron, for, whatever might be the cause, the gas cannot find its way out if the metal is viscous—good hot iron hides much faulty venting, etc.; wrong mixture of metal for the particular type of casting; and last, but not least, the difficult, and very often absurd, design of the casting, which makes it practically impossible to conduct gases rapidly enough away from the mould or core.

Cavity and Porosity due to Loose Sand, Slag or Sullage.

One or more of the following reasons might be the cause of cavity and porosity under such a heading:—Scabbing of cores and moulds, which will be described later, is a prolific cause of dirty castings, the sand and blacking so disturbed floats about on the metal, and is most likely found above the locality of the disturbance, but sometimes far removed from the seat of the trouble, which will depend on the position of the runner gates and shape of mould and cores; loose sand left in mould, perhaps hidden from view under cores or projecting portions of the mould, and can be introduced by scraping of cores on prints, or from careless handling of cores detaching pieces of sand; crushing of joints of mould and cores, especially in dry-sand and loam; sand may fall down the runner or riser gates when making up the bush for the reservoir of metal after the mould has been closed. To prevent such a possibility when closing important work, the pouring and riser basins are completed on the top side of moulding box before closing; careless rod-feeding, so that the sides of the feeding gate is scraped and sand pushed down into the casting. This happens particularly when the metal has become sluggish; sullage floating on the feeding head metal can also be carried into the casting by the rod; erosion of mould in various places introduces sand, such as soft ramming around gates, breaking away of the keen edges often formed on the mouth of the main down runner, which happens especially when placing stoppers over the openings, and if the bottom portion of the in-gate which receives the first blow from the falling metal was examined more frequently, some of the mysterious dirty patches found on castings would be explained, or if a casting is run by top drop-gates, erosion of the bottom side of the mould may take place due to

* A Paper read before several branches of the Institute of British Foundrymen.

the blow from the falling metal. Sometimes the size of the mould or cores are scraped by the falling metal, especially if there are shoulders of sand or the moulding boxes are not placed quite perpendicular, so that metal can fall clear to the bottom of the mould without impinging. Pieces of mould may break away and wash before metal; arrangement of gates, so that eddies are created near entrance; sullage and slag may be sucked down with metal if there is insufficient and incorrectly-formed reservoir-capacity in the pouring basin to feed the down runners, or main gates may be so situated in the pouring basin that a whirlpool is formed. Again, it may be due to careless pouring, allowing head of metal to sink too low, and to faulty skimming; using blacking excessively, especially on green-sand, much of which washes before the flowing metal. This happens also with dry-sand, loam and cores with insufficient binder in the face-dressing, or subjecting moulds to too high a temperature when drying, so that binder has been burnt out or weakened, due to expansion of the sand grains and passage of steam. After the mould has been closed a gagger may be touched or moulding box jarred, and the adhering sand on the inside of the mould dislodged.

It has been stated that some of the strange, dirty-looking patches discovered near in-gate entrance may be due to air being drawn down runner, which causes oxidation of the graphite. It is probably due to excessive local heat about runner entrance, especially if metal impinges immediately on a core, the spots so overheated allow a freer exit for the surrounding mould gases. In any case, the in-runner should not be placed near an important or machined surface, if it can be avoided, because dirt or open-grained structure is possible in that locality.

Scabbing of Moulds and Cores.

The term scab is used to describe a rough incrustation which forms on castings when gases are generated rapidly locally or are unable to escape speedily enough through the pores of the sand and vents, or rapid expansion of face of sand locally, thus a portion of the sand face is pushed forward into the metal, creating extra thicknesses at these points and sand cavities at others.

Scabbing can be caused by many of the reasons described above, and may be due to:—Absence of or incorrect venting; too much moisture in sand, especially when green-sand moulding; insufficient drying of cores and moulds when dry-sand and loam moulding is practised; hard and also soft ramming of sand, particularly when local; incorrect sand and mould-dressing mixtures; excessive tool sleeking of mould and cores; location or bad design of runner and riser gates; a portion of the mould or core, due to its shape, may expand and become detached; nearness of mould and core irons to surface of sand may cause a piece to become loosened, either because the body of sand is so thin and weak that it scales off, or the core iron expands and pushes the sand before it into the metal; hook holes provided in cores may not receive correct attention, such as drying, venting, or sprigging to the already dried core; pasting sand on an already smoothed surface of the mould or core; suction created when withdrawing pattern from sand, may cause a part of the mould to become loosened, and if it misses the eye of the moulder and he does not cause the affected spot to adhere to the main body of sand, it may be detached when the metal flows around it; an excess of binder in mould and core washes will cause the face of sand to contract and buckle after drying; making up of joints of assembled sections of cores with new material instead of old or sand more nearly corresponding to nature of core which has been subjected to the prolonged drying temperature; blacking cores whilst hot and allowing them to cool before pouring metal; inserting hot cores in green sand moulds so that moisture is formed on certain parts of the core or mould; cores absorb moisture if allowed to stand in a green sand mould too long, and may scab; oilsand cores may be so weak because of the lack of binder or drying at too high a temperature that blacking, especially if core is hot, when washed may be rapidly absorbed and adhere in thick layers, to be disturbed later when the metal touches it; explosion of gases in vents may cause either mould or core to scab or even to shatter; if, when making a loam core, the last layer of loam applied is thin, it is not unknown to find a scrap casting, because when the metal has poured around the bottom side of the core the sand expands, the tendency being to push upwards where there is the least resistance, and this thin layer of loam buckles and scabs away when the metal closes around it; buckle scabs may be caused by a weak core bending perhaps because of insufficient support by chaplets or studs, etc.; vents too near surface of mould allow gases to blow through into metal and detach the surface of the sand; with certain medium and heavy castings, especially in green sand, metal may be admitted at too high a temperature; in some cases omitting to face-sprig the mould and core opposite the runner entrance and about the shoulders of sand over which metal must pour to fill a lower part of the mould; allowing metal to penetrate vents blocking the exit of gases.

Moulders have been known who have stood and stamped on large slender cores with a view to carrying the core solidly down into the mould print and experiencing at once any weakness in the support prints rather than later, when more cores were built upon it. After the casting has been taken from the sand, much surprise has been expressed when scab sand has been disclosed. When the casting has been broken up the reason became very evident. When stamping on the core print the moulder had caused the core iron to move and strike the sand above it some distance in the mould.

Contusion of Mould and Core Joints.

When extracting a pattern from mould, especially one with little draft, joints tend to lift, and after the mould is finished joints may stand quite proud, so that when boxes are brought together crushing takes place. In dry-sand and loam, thick blacking on the joints or when the mould has been subjected to a rather high temperature, swelling of the sand may take place, and if the joint clearances have not been cut, as is usual with dried moulds, joints are contused. A crush on a dry sand mould is usually more serious than is the case with green sand, because the dried sand, although strong, is not plastic like green sand and crumbles. Thus it is common in dry-sand practice to pare joints and core prints of mould whilst in a green state. Poorly-fitting box-locating pins may guide the top-side of the mould too keenly on one side of a core print or an irregularly-formed joint. This may happen if the top box is placed unsteadily. Box-joints, especially if unmachined, may be so irregular that, unless packing is wedged into the open joints in various places before clamping or bolting together, a very serious crush may be the result. A scrap casting from this type of crush can be guarded against by a trial closing of the moulding boxes and clamping together before coring. It is good practice with heavy bedded-in work, such as bedplates, etc., to try on the top boxes after the mould has been finished to the point of blacking and whilst the mould is still green. With an absence of, or insufficient reinforcement, to the bottom or top sides of prints, the weight of core may sink in the bottom print or burst the top print when the metal-pressure is exerted on the core. With heavy bedded-in work serious crushes are sometimes experienced, due to lack of foresight in placing bearers leading from below the bottom side of the mould to the joint face to receive the weight of covering box. Sometimes too much weight or bolting may be applied. Cores may be canted in a mould, thereby fouling a print formed on the top side of the mould. Boxes are sometimes placed together the reverse way to the right one.

Escape of Metal from Mould.

Considerable waste can be recorded under this head, and the causes can be ascribed to:—Metal leaking through incorrectly-formed sand joints; runner gates too near the sides of the moulding box, especially if the flask joints are not machined; the joints of the box may be held apart by cores, which are too large for mould prints or by failing to remove sand which falls on the iron joint of the box; nearness of the lower side of the mould to the bottom side of the box, so that if not well-

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weighted down, in addition to clamping or bolting at the joints, and the sand bed well formed, the metal will force its way out with little hope of stopping the flow; soft ramming of bottom side of mould will show up its weakness when the full head pressure is reached and the metal escapes; omitting to clamp the box together sufficiently or not at all, or placing too little weight on the boxes. Metal may force its way through surface of core due to nearness of a hay or straw band to the sand surface or in an ordinary sand core through soft-rammed places; proximity of vents to surface of sand, either in ordinary sand mould or core, may cause scab as described above; metal can then escape through the vent thus exposed. The print of a core may be too small for mould print, perhaps because the core box has become worn on the joints by usage, or the coremaker unduly rubs the joint of core before assembling, or the print of the pattern may have become enlarged because the two halves do not sit together, the metal escaping through the spaces thus formed. An escape to the vents is sometimes made when cores are imperfectly jointed and sealed; moulding box may be strained due to weakness or abnormal head pressure, causing an opening of the mould joints or fissures in sand through which metal issues. A portion of the top side of mould may be pushed upwards by metal, because of a lack of bars or soft ramming. Again, an explosion of gas in a mould when it is stated to be blowing may so strain the mould and cores that metal finds its way into vents and also through joints of mould. Displacement of cores will allow metal to enter the vents.

Heavy castings, from perhaps a couple of tons to, say, fifty tons, and which are made and constructed practically below the moulding floor line, must be specially cared for, if metal is to be held securely. Brick- and metal-lined pits are essential for safety with certain weights and shapes of castings, especially if the type does not lend itself to moulding with the usual sturdy prodded building rings. The bottoms of these pits, in addition to metal plates on the bottom side, have strong cast- or wrought-iron stretchers underlying the plates, which are made to receive strong vertical bars, used to bolt down the top boxes after the mould has been assembled. If, as is the case in some foundries, no specially-constructed pits exist, a known good section of the floor is chosen and the rough hole excavated by labourers. The moulder then examines the bottom and sides for weakness. It may be that he can strengthen a soft place by ramming, but often he is compelled to place loose plates in front of these danger spots, because the sand may be too dry and the extent of the soft place unknown. However, in spite of the ingenuity of the moulder, even such foresight is sometimes beaten, and metal escapes, spoiling an extremely expensive casting.

Displacement of Cores by Metal.

Much ingenuity can be exhibited when securing cores in moulds so that as little solid metal support be introduced into the casting sections as is consistent with safety.

Cores may have ample mould-print or seatings to avoid using chaplets, studs or nails, but the moulder fails to reinforce these sand supports by inserting material which is stronger and more resisting than sand, so that core either sinks by virtue of its own weight or is crushed upwards when the fluid pressure which is exerted by the molten rising metal. In some cases, chaplets or studs are placed on the prints of the pattern when ramming the mould, securing them either under a bar or by clamping or weighing, as is the case with those which penetrate the casting section. Chaplet, stud or nail may be forgotten, or may be too weak or insufficient of them used to fulfil the duty expected. Studs or chaplets may sink into the core or mould because the sand surface is too weak to withstand the weight or core or pressure on top side when the metal rises in the mould. Chaplets are sometimes wedged too lightly or too heavily. Studs may be displaced by movement of cores by the flow of the metal, especially those which are simply wedged vertically between cores or core and mould; they should in certain cases be nailed to the core or mould. Weakness of core irons may cause the core to bend, also to disturb other cores. Hooks in cores, if placed at an angle, may be too weak and allow the core to lift by straightening the hook somewhat.

During the author's apprenticeship period at a large engineering firm, which was then being run on American lines, provided many amusing incidents. He well remembers the horror on the face of a moulder when he discovered three days after having poured a large casting, that he had wedged down the stem of a straight-limbed gagger which protruded above the top of the moulding-box face alongside the stem of a chaplet. It might be pointed out in passing that it was an American system to use straight-limbed gaggers, which often stood well above the top of the box.

Leaking Around Studs, Chaplets and Nails.

It is erroneously thought by many that the chaplet or stud fuses; this only happens very rarely. As a matter of fact, this article would not be fulfilling its duty if it did melt, because one can imagine a core floating, or in some instances sinking in the metal.

Faults in this section may be due to pouring with dull iron so that metal does not cling or knit closely enough to these inserted pieces of solid metal; omitting to allow extra metal around chaplet stems, a good button or pad can often be arranged around the stem on the inside of the casting and out of view of critical eyes. The running of a casting may be so slow or gates may be so located that these pieces of cold metal have little chance of becoming heated before the metal flows about them; a deposit of moisture may form on the chaplet or stud by placing warm cores and closing the mould too early. When core is displaced the metal section is thinned, and consequently less metal around the stud or chaplet. A stud may be too strong for a given section of metal. Defective tinning or rust on chaplets, etc., is a frequent cause of leaking.

Moulders have been noticed placing the nail stud or chaplet, and then deciding to damp the mould, and incidentally the chaplet, etc., and in other cases when dry-sand moulding fixing nails or chaplets before wet blacking the mould. Of course, the blacking adheres to the nail, and forms a parting with the metal.

Misplacement of Cores.

Chaplets or studs may be inserted which do not correspond with the desired thicknesses; the breaking down of sand prints and subsequent incorrect repair, which might be full or short, is a further cause. Insufficient print, or absence of a protruding print, may be the cause of wrong location of cores. Others are:—The pattern or core box may become so much worn that position of cores alter; rubbing core prints before placing cores; when placing loam cores, such as for liners and cylinders, cores are sometimes placed without first ascertaining the thicknesses. It is very desirable to check by the aid of clay stamps under and above the cores; absence of or indistinct guide or setting pieces on mould and core prints may be the means of locating cores wrongly. Often, if the setting or locating piece is not bold, the moulder may tool it over, especially if for some reason the mould has been dragged and broken at this point. On one occasion a dull moulder cut off a bold guide on his sand print, so that he placed cores the reverse way about in four out of six castings.

Short Run Castings.

Shortage of metal due to miscalculation is almost an everyday occurrence in foundries. Metal may escape from mould, and is run short if a surplus of metal is not available; this is an everyday mishap. Misplacement or lack of runner gates may not allow metal to completely fill the mould; this may happen also if metal is dull, or a blow-off riser is not provided above thin or pocket-like sections.

(To be continued.)

Bagnoli Works in Italy.—Owing to the increased demand for iron and steel in Italy, the Ilva Company has decided to re-open their works at Bagnoli, on the Bay of Naples, which have been closed down since 1919. For the present only one furnace is to be blown in, with a daily capacity of 200 tons of pig-iron.

Institute of British Foundrymen.

The East Midlands Branch Biennial Dinner.

The East Midlands Branch met on February 14 at the Great Central Hotel, Loughborough, for the biennial dinner. Mr. S. H. Russell, of Leicester, was in the chair, and those supporting him included the President of the Institution, Mr. R. O. Patterson, Dr. H. Schofield, M.B.E., Ph.D., B.Sc., A.R.C.Sc., etc. (Principal, Loughborough College), Mr. G. F. O'Riordan (Principal, Leicester College of Technology), Mr. V. C. Faulkner (Vice-President of the Institution), Professor Bullerd (Nottingham University), Mr. Orchard (President, Leicester Association of Engineers), Mr. H. H. Moore, of Loughborough, and Mr. W. T. Evans, Derby (Past-Presidents of the Branch).

Securing suitable Foundry Apprentices.

Following the loyal toast from the chair, MR. O'RIORDAN proposed "The Institute of British Foundrymen." He understood from THE FOUNDRY TRADE JOURNAL that the Institute had now reached its majority, and he would like to take the opportunity of congratulating the founders. Between 1904 and the war the foundry was one of those places of ill-repute, and was almost unheard of. The foundry in his short time in the shops was a corner of the yard, with plenty of fresh air diluted with a smell of sulphur. Those times have changed, and the modern foundry is as delightful and as cheerful a place, as far as engineering shops, as one could wish. He was informed that the immediate object of the Institute is the education of the foundryman, and no higher ideal could be imagined; it is the only sound object in a progressive institution. If the Institute educates those responsible for the industry, all else goes without much trouble. It is a matter of great gratification to those who are responsible for the technical side of industry that the Institute has devoted considerable attention of late to the educational training of its members. Some of them have been rather interested in the recent remarks which have been made by the President of the Board of Education, and from these there was clear evidence in his mind he would spend money if he could find there was likely to be rigid co-operation between industry and the Colleges. Now that was really what the technical colleges are aiming at.

One of the primary views he had in attending their last meeting was to find out exactly what they wanted and see if they could give assistance generally, and make technical schools more useful to industry. After that meeting he entered into a discussion with Mr. Kingdom, of the Wyggeston Boys' School, and he had invited all the heads of the secondary schools and the colleges in Leicester to meet him to thrash out the problem of securing a better class of labour into the foundry.

MR. PATTERSON, whose name was coupled with the toast, thought they could congratulate themselves on the amount of work put through by the Institute for the good of the foundry worker and the foundry industry as a whole. The main object of their Institute was to bring knowledge to bear upon their everyday problems, to educate every man in the foundry, and to teach him something about metals. It was astonishing to find yet that we know so very little about cast iron—he was not speaking of professors and scientists, but of the average foundryman. It was the oldest branch of the whole of the engineering industry. It was for the scientists to teach the poor outsiders, the plain foundrymen, a little more than they have done already. It had always been a very difficult thing for a highly-trained man to impart that knowledge to one who knows very little about the subject, and there was one aspect of this question which always struck him: How was it that a man like David Maclain can impart his knowledge in such a simple way and to such good purpose, and our scientists seem to make such a fearful business of it. They must look upon the boys as the most important thing they had to deal with; upon them depends the whole future of the industry. With regard to the moulders, they are the most skilled craftsmen in the whole of the engineering industry. It was his main object to cut out the donkey work in the foundry. The South are more advanced than the North, particularly in regard to machine moulding—perhaps owing to the repetition orders obtained. As well as machine moulding, there is much hard work in the foundry which should be done by machinery, such as sand handling, mixing, and so forth. It is entirely wrong that a moulder should be asked to do this class of work; he requires the craftsmanship side developing. He was across in the States a few years ago, and was particularly struck by this aspect in their foundries. They seem to have been driven to it by sheer necessity to organise their foundries on a fool-proof basis. Finally, he congratulated the Branch-President and members on having such a representative gathering. Many had had a long journey, which showed enthusiasm.

MR. FAULKNER (Vice-President of the Institution) gave the toast of "The East Midlands Branch," which he said was probably the most difficult branch to organise in the whole of the Institute, because it was spread about throughout a very large area, and they could not but admire their wonderful enthusiasm which kept them together. They had had a fine list of presidents in Mr. Moore, Mr. Evans and Mr. Russell, and at the same time they had a wonderful secretary in Mr. Bunting. These were all factors which contributed to their success.

MR. RUSSELL in reply said he felt deeply the kind and cordial way they had received the toast. The Branch as had been said was not a very easy one to run, and he was very grateful to the members for the way they backed him up and spent their money and time in attending. They had excellent relations with the Sheffield Branch, and each year arranged a joint visit to some works and met later together for discussion. He thought the idea of co-operation between the branches was a good one and might be developed with advantage to the Institute. He had nearly reached the term of his office, having served for 21 months, and the time had been a very pleasant one, for he had had the loyal support of every member.

MR. H. H. MOORE, proposing "The Visitors," said their guests represented the scholastic and technical side of industry, and said with regard to the educational side of the branches these institutions had given them the greatest help, while Dr. Schofield in another direction had shown he could do a great deal of work for the foundry trade.

DR. SCHOFIELD responding said he took it as a particularly good augury they at any rate realised that the scholastic side has something to offer and something it could do for them, and for that they were very grateful. To a very large extent the assistance it could give depended upon themselves. He was more and more convinced it was for industry to tell them what they could do for they had the means and, he hoped, the ability to try and do it.

Divorce of Universities from Industry.

Referring to Mr. Patterson's statement that a Principal in the North could not teach apprentices to the foundry trade unless they had matriculated, he said no individual who wanted to talk common sense would ever suggest that before beginning to teach young people they must pass first such an examination as matriculation, which was alien to any practical developments, and only applicable as a school-leaving examination taken at school, as it should be, so that if a boy wishes he could proceed to a University. But otherwise it had no reality to the job of foundry work. Our Universities to-day, said the speaker, are altogether too academic and tending to drift entirely apart from industry for which they are supposed to provide, as part of their job, the well-trained man with the requisite technical knowledge. But there is a great tendency for those

people who were in a scholastic job to cut themselves apart from industry, and this was one of the real problems, to staff our institutions with men who are alive to the present needs of industry. This was a problem leaders of technical education are giving a considerable amount of thought to at the present day. If they picked a first-class man of industry to place him in the technological department of the University he tended to lull himself to sleep and drift further away from the industry of which he should be the teacher for the young people. This was a very serious matter, how to keep the teachers right at the heart of things by a term in the shops. It was a difficult subject, because firms are not particularly anxious to have these men, and the men themselves were not particularly anxious for the refresher year. Every college could not adopt the plan as at Loughborough, but it had had its success. There was a very keen industrial spirit, and they had introduced an element of commercialism and industrialism with considerable success, and he was very pleased to think their Secretary was one of his best colleagues. One of the things they had done with a considerable measure of success had been to bring the practical man to talk to students. He had always said if he had to choose between the man who cannot teach but knows his job and the one who taught more from book knowledge he would choose the former every time. The man who really knows his subject from practical experience is always in a position to tell someone else about it, and he would rather have it that way than a fluent speaker with only a book acquaintance with what he talks about. Mr. Bunting was a very shining example of that type of teacher who met with a great deal of success in the work of talking to boys who would be the founders or engineers. He took it from the fact they had invited them they realised they were co-operators along the lines they wished to go. If they had not got all they required, let them ask, and they would try and increase those facilities. It was from industry that he got the driving force for the governing body, and try and see how far technical education can better co-operate with industry and divorce itself from the altogether too academic side it was too prone to run to.

An excellent musical programme was given during the evening.

Presentation to Secretary, East Midlands Branch.

On the occasion of the dinner of this Branch, on February 14, a presentation was made to the Secretary, Mr. H. Bunting, of Derby. This took the form of a gold watch suitably inscribed, and as there had been further donations since the watch was purchased, the money was used to purchase a present for Mrs. Bunting.

Mr. S. H. Russell, the Branch-President, said the Branch was formed in 1914, following upon the Convention held in Leicester. Mr. Pemberton was really the pioneer in the movement, but he did not hold the office of Secretary for more than twelve months. Mr. Bunting followed, and had been their Secretary for eight years, and was still as active as ever. He had received letters of apology for absence from Mr. Sidney Gimson, a past-President of the Institute, and Mr. James H. Wood, who wrote, that owing to his absence in West Africa, he could not keep in close touch with the Institute. As a civil engineer, using a fair number of castings, which have to be transported 5,000 miles by sea, then 500 miles by rail, and then dragged 200 miles by natives, he was always anxious to see progress made in castings strong and as light as possible.

Mr. Patterson, in making the presentation, said they had a Secretary whom they should appreciate, and having found a good man, his advice was to support him for all they were worth.

In his reply, Mr. Bunting assured them how grateful he was for the mark of esteem. It was a pleasure to do the work, in which one grew more interested the longer one was in it. He well remembered their first meeting, when they really started the Branch, in 1916, with a few members. It was not a very great start, but they put their backs to the wall and carried on. The next attempt was a real success, for they came to Loughborough for the meeting, and the room was packed. They had had some excellent Presidents and very enthusiastic members of the Council. They were also indebted to Professor Schofield and Mr. Driver, of the Loughborough Technical College, for the great assistance given. It had been mentioned the Branch was a difficult one to work; they had members as far away as Lincolnshire, to the south of Leicestershire, north to Chesterfield, so they would see the area was great and entailed a considerable amount of travelling on the part of the members. He was reminded of a poster inviting people to join the Army and see the world at their country's expense; their motto seemed to be, join the East Midlands Branch and see the country at your own expense.

Catalogues Received.

Sand Preparation.—The S.A. des Etbs. Ph. Bonvillain et E. Ronceray, of Choisy-le-Roi, near Paris, who trade in this country through the Universal System of Machine Moulding, Limited, 97, Queen Victoria Street, London, E.C.4. This is a revised section for inclusion in the firm's general catalogue. We notice both in this and a previous catalogue which we reviewed no mention is made of the existence of a British or other foreign office, which, from the British point of view, seems strange. The catalogue describes and illustrates successively belt, motor-driven and portable rotary riddles; jolting riddles; ball mills; roller sand mills, with and without automatic discharge; aerators, both fixed and portable; oil-sand core mixers; portable core stoves; "sausage" type of core-making machine; air-drying core-making preparation; tumbling barrels; portable mould drying units; grinding machines; pig-iron breakers; air compressors; gate-cutting machines. Altogether the catalogue forms a comprehensive collection of machines covering the preparation of sand for moulding and core-making purposes.

Steelworks Plant.—Messrs. John A. Smeeton, Limited, of 15, Victoria Street, London, S.W.1, have sent us a beautifully illustrated book outlining the development of the Demag concern of Duisburg, of which they are the British agents. It contains 250 pages, and about the same number of illustrations of their own works and plant which they have supplied. It represents the highest type of modern publicity. We understand there are a few copies still remaining for distribution amongst our readers, and the recipients can count themselves fortunate.

Chromite Bricks.—The General Refractories Company, Limited, of Kelham Island, Sheffield, have sent us a copy of a 12-page brochure dealing with Coroma (chromite) bricks, printed in French. They are to be commended on this enterprise, for such a pamphlet covers a much wider area than merely France and Belgium. For instance, most Spanish and Italian furnace managers also read French.

Electric Overhead Cranes.—The Vaughan Crane Company, Limited, of Openshaw, Manchester, are circularising the foundry trades with a folder carrying illustrations of electric cranes and runways.

Publications Received.

Spectrum Analysis with Hilger Instruments. Published by Adam Hilger, Limited, 75a, Camden Road, London, N.W.1. This 24-page booklet can scarcely be designated a catalogue, as it contains but references to the publisher's catalogue of scientific instruments. Its five sections contain all the information necessary to show managers of technical departments the principles of spectrum analysis and the use of spectrometers and spectrographs. Spectrum analysis can reveal material information unobtainable by any other means. We understand the booklet is obtainable on mentioning The Foundry Trade Journal.

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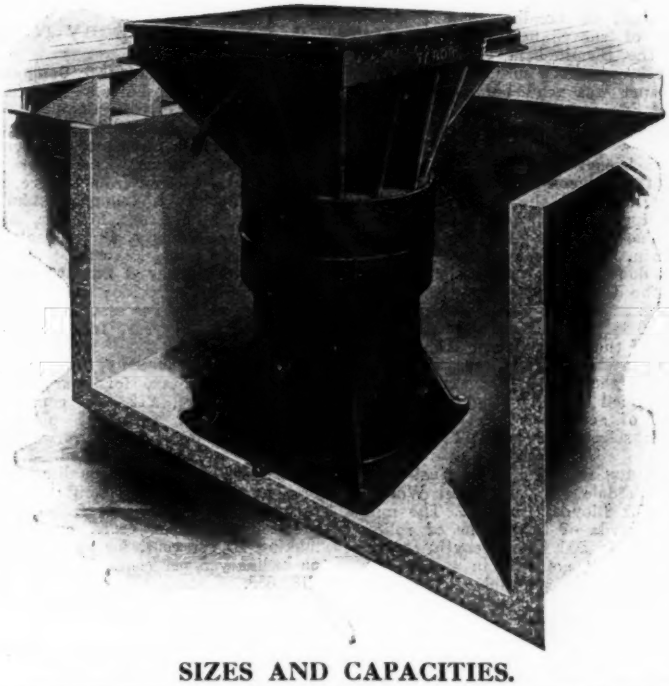

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6"	36" × 36"	1,000 lbs.	13"	42" × 60"	5,500 lbs.
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WORKS: TOTTENHAM, LONDON, N.17.

Trade Talk.

The Dover yard of the Stanlee Shipbreaking and Salvage Company, Limited, is reported to have closed down on Wednesday.

The imports of foreign iron ore at the Senhouse dock at Maryport last week amounted to 3,700 tons. This is the first cargo that has arrived this month.

The British Insulated and Helsby Cables, Limited, have decided to change the name of the British Union lamp, which they manufacture at Huyton Quarry, near Liverpool, to the B.I. lamp.

The General Electric Company, Limited, are supplying the Admiralty with a large contract for the supply of 50,980 Robertson carbon filament lamps, and the G.P.O. an order for 10,000 telephone switchboard lamps.

The British Engineering Standards Association, as a result of a fully representative conference recently held at the Institution of Civil Engineers, has decided to set up a Sectional Committee to deal with building materials generally.

An interesting lecture on "The Theories of the Operation of the Blast Furnace" was given by Mr. David Sillars, Middlesbrough, to the members of the West of Scotland Iron and Steel Institute, in the Technical College, Glasgow, on February 20.

Mr. S. A. Sears, of Manchester, lectured in the Mappin Hall, Sheffield University, on Monday, on "Gas Furnaces in the Steel Industry." Mr. A. Senior, president of the Sheffield Society of Engineers and Metallurgists, under whose auspices the lecture was held, presided.

Mr. H. S. Primrose, of London, read a paper before the members of the Staffordshire Iron and Steel Institute, at the Birmingham University, on Thursday of last week, upon the subject of "Stainless Iron." This paper was read before the Manchester Association of Engineers in December last, and was dealt with in the Journal for January 15, 1925.

Two tenders have been received in Australia for the construction of the projected two cruisers, one from the Cockatoo Dock and the other from the Welsh Island Yards, together with one British tender for the building of one vessel in Australia, and the other in Great Britain. A number of tenders have been received in London for the construction of one or both cruisers in the United Kingdom.

Applications have been invited for an issue, at 96½ per cent., of £2,500,000 4½ per cent. guaranteed debenture stock, 1931-1955, of the North British Aluminium Company, Limited. The stock will be repayable over the years 1931 to 1955 by the operation of a cumulative sinking fund to be applied in purchasing stock at or under par (exclusive of accrued interest) or in redeeming at par stock selected in sums of £100 by drawings.

An exceptionally large rolling mill has just been completed at the Clydesdale Iron and Steel Works, Mossend, of Stewarts & Lloyds, Limited. The mill has a capacity of upwards of 5,000 tons of rolled products per week, and is 500 ft. in length. The process of rolling will result not only in a considerable saving of labour, but in economies which are to be secured from rolling long plates, and also by rolling to width.

The Vickers-Spearing Boiler Company, Limited, Bank Buildings, 20, Kingsway, London, W.C.2, have recently received a repeat order for three 15,000 lb. cross type water tube boilers, from the Anglo-Scottish Beet Sugar Corporation, for their Nottingham factory, as well as a repeat order from the Wimbledon Corporation Electric Supply Dept. for one 50,000 lb. cross type boiler, fitted with an Illinois chain grate stoker and flat suspended arch.

The Premier Electric Welding Company, Limited, have decided to discontinue their Swansea establishment, but arrangements are being made to extend the company's facilities at their Abbey Wood factory, London, S.E.2. The marine and general repair branches at London, Liverpool, Leith, etc., are not affected by the discontinuance of the Swansea branch. The Premier Electric Welding Company, Limited, are a subsidiary concern of Nobel Industries, Limited.

The Trade Fair at Posen (Poznan), Poland, is to become an international affair this year, and is now definitely fixed to take place from May 3 to 10 next. The Fair is intended to contain exhibits including the following trades:—Electrotechnical industry and lighting, metal industry, chemical industry, building and engineering, raw materials, and inventions. The available space comprises an area of 350,000 square meters, of which 40,000 square meters are in concrete exhibition building. Details may be obtained from the British and Russian Transport Company, Limited, 6, Lloyds Avenue, E.C.3., whose agents have been appointed the official forwarding agents.

Obituary.

Sir Edward Thorpe, who died on February 23 at Whinfield, Salcombe, South Devon, aged 79, was keenly interested in fostering the growth of British chemistry. He was Emeritus Professor at the Imperial College of Science and Technology. His contributions to chemistry were many and varied, and among the most remarkable perhaps was his "Dictionary of Chemistry," which appeared in 1893. He was President of the Chemical Society, and in 1921 President of the British Association.

Mr. John M. Henderson, chairman and managing director of John M. Henderson & Company, King's Works, Aberdeen, died at his residence, 55, Queen's Road, Aberdeen, on February 19. Mr. Henderson, who was the chief partner in the large engineering firm of J. M. Henderson & Company, Limited, which a comparatively short time ago was formed into a private company, gained his earlier experience in the business established by his late father, to which he succeeded. Into the development of the works Mr. Henderson threw his entire skill and energy. Specialising in hoisting and transporting machinery, especially in Blondin cableways for mines and quarries, and in cranes and stoneworking appliances, the firm did business on an extensive scale. So soon as the necessary formalities permit, the family of the late Mr. Henderson, who are retaining their late father's interest in the company, will be represented on the board of directors.

Company News.

Scottish Iron and Steel Company, Limited.—Dividend on ordinary shares, 4 per cent., less tax.

Frederick Braby & Company, Limited.—Interim dividend, 5 per cent., less tax, on ordinary shares.

North British Locomotive Company, Limited.—Dividend on ordinary shares for year, 5 per cent., less tax; transferred from reserve, £85,000.

Bruce Peebles & Company, Limited.—Dividend on preference, 2½ per cent. for year, making 10 per cent.; dividend on ordinary, 10 per cent. for year, less tax; bonus, 5 per cent., less tax.

Wallsend Slipway & Engineering Company, Limited.—Net profits, £30,156; brought forward, £35,834; final dividend, 4½ per cent. on ordinary shares, making 7½ per cent. for year, free of tax; carried forward, £14,171.

Delta Metal Company, Limited.—Dividend, 12½ per cent., free of tax, for year; depreciation, £6,777; taxation reserve, £12,000; general reserve, £5,000; reserve against premises, plant, and installation account, £10,000; carried forward, £12,488.

Mather and Platt, Limited.—Net profits, £275,034; transfer to income-tax equalisation account, £46,023; brought forward, £178,393; interim dividends on preference and ordinary, £78,183; final dividends on preference, 2½ per cent., on ordinary 5 per cent., making 10 per cent. for year, free of tax, and bonus on ordinary 5 per cent., free of tax; carried forward, £182,855.

Contracts Open.

Hursley, Hants.—Gas and oil engines and pumps, for the Hursley R.D.C. Messrs. Weston, Burnett & Thorne, civil engineers, 24, Portland Street, Southampton.

Bridlington, March 16.—Electricity stores, etc., for 12 months commencing April 1, for the Town Council. The Borough Electrical Engineer, Electricity Works, Bridlington.

Maltby, Yorks, March 10-17.—Installation of low-pressure heating apparatus, for the West Riding Education Committee. The Education Department, County Hall, Wakefield.

Salonica.—Threshing machines, straw cutters, pressers, reaping machines, reapers and binders, for the Greek Refugee Colonisation Department. The Department of Overseas Trade.

Cairo, Egypt, March 23.—Metals required during the financial year 1925-1926, for the Secretary-General, Ports and Lighthouses Administration, Arsenal, Alexandria. The Stores Department, Arsenal.

London, S.W., March 13.—Brass foundry work, for the Commissioners of His Majesty's Works, etc. The Controller of Supplies, H.M. Office of Works, etc., King Charles Street, Westminster, London, S.W.1.

Cork, March 9.—Steam road roller of the three-wheeled type with compound engine, full-length awning and compensating differential gear (a three-tine fixed scarifier to be quoted as an extra), for the Corporation. Mr. W. Hegarty, town clerk, Fitzgerald Park, Cork.

The Essential Properties of Sand for Oil Cores

Mr. C. W. Holmes, M.Met., the well-known foundry metallurgist, in his paper on "The Technical Side of Oil Cores," insisted that—

Core sand particles must be rounded and of regular size. Rounded grains give better venting properties than angular grains. Clean sand, i.e., free from clayey matter, requires less oil than do naturally-bonded or dirty sands.

RYARSH SAND.
20 magnifications.

The Ideal Sand for Oil Cores

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IRON AND STEEL MARKETS.

Pig-iron.

MIDDLESBROUGH.—Though movements in the Cleveland iron trade continue comparatively inactive, the general tone of markets is somewhat more hopeful, with more inquiry in evidence on home consumption account. As contracts to cover first quarter requirements are now running out, consumers are inclined to make fresh commitments on the fairly moderate values now quoted, although buyers are by no means yet convinced that the lowest limits of prices have yet been reached. In the export section, fair quantities are now being disposed of in prompt lots, especially to Germany and Central Europe. Moreover, with the approach of spring and the re-opening of the Baltic, there should be a revival of inquiry from Scandinavia, and traders look for more business in this direction next month. Quotations are as follow:—No. 1, 83s. 6d.; No. 3 G.M.B., 78s. 6d.; No. 4 foundry, 77s. 6d.; and No. 4 forge about 76s. 6d. per ton.

LANCASHIRE.—Business in the Manchester market is quiet, and mostly confined to small parcels. The local foundries are still short of work, and consequently demand is much below the average level. So far the makers of Derbyshire No. 3 foundry iron maintain the quotation at 81s. at furnaces, but concessions are reported obtainable for sizeable parcels of this quality. The prices for Scotch iron are rather variable. Some sellers are still holding out for 105s. per cwt. delivered, but they are not able to do any business. Apparently down to 103s. has been accepted, but there is little demand at any price.

Metals.

Copper.—Fluctuations in values in the standard market recently have been within a slightly narrow margin, and on the whole conditions of this metal may be regarded as consistently steady. The recent fall to £65 for three months' delivery was accompanied by free selling. The main influences were the temporary adverse aspect of the American share markets and the French exchange, which afforded another opportunity to the bear party. In addition to this renewed cheap offers of second-hand American fine copper made their presence felt in face of the cautious attitude of trade buyers. German resales, too, were reported, chiefly through Hamburg. Current quotations:—*Cash*: Thursday, £64 10s.; Friday, £64 7s. 6d.; Monday, £63 15s.; Tuesday, £64 2s. 6d.; Wednesday, £64 5s.

Three Months: Thursday, £65 7s. 6d.; Friday, £65 5s.; Monday, £64 15s.; Tuesday, £65 2s. 6d.; Wednesday, £65 5s.

Tin.—Movements in this section of the market disclose few changes in the general position, the variations in values only amounting to a small amount either way, while the American demand has been insufficient to influence operators to any marked extent. Buying for Welsh consumers has remained disappointing, but, on the other hand, purchases on Continental account have been maintained on a fair scale, and prospects in that direction are considered good. The increased Continental takings for some little time past have approximately made up for the shortcomings on Welsh account. Current quotations:—*Cash*: Thursday, £261 12s. 6d.; Friday, £258 5s.; Monday, £250 5s.; Tuesday, £251 5s.; Wednesday, £253 10s.

Three Months: Thursday, £264 10s.; Friday, £261 5s.; Monday, £253 15s.; Tuesday, £254 10s.; Wednesday, £257.

Spelter.—Professional dealings in this metal have caused moderate fluctuations in values, and the chief feature has been the widening of premium on spot. At the same time, sentiment is rather mixed. Galvanisers seem inclined to buy at the present level, and thus on the whole the market should be able to hold its own. Continental offers are still very limited. It is recognised that any increased trade demand could be met only at a higher price. Current quotations:—*Ordinary*: Thursday, £37; Friday, £37; Monday, £38 8s. 9d.; Tuesday, £36 1s. 3d.; Wednesday, £36 2s. 6d.

Lead.—The market for soft foreign pig is now influenced largely by the operations of the principal dealers. Realisations by tired holders and a decline in the New York quotations have been responsible for a further setback, particularly for May shipment; but on good support and covering purchases the market recovered substantially. The market account is still over-sold, so that the premium on spot is likely to be maintained, and consumers will be compulsory buyers if the market shows signs of continued firmness. Current quotations:—*Soft foreign (prompt)*: Thursday, £38; Friday, £38 2s. 6d.; Monday, £37 15s.; Tuesday, £38; Wednesday, £37 7s. 6d.

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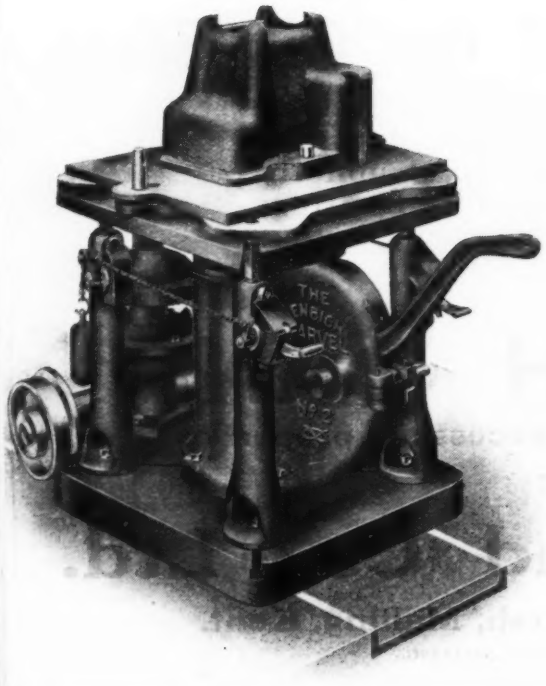

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